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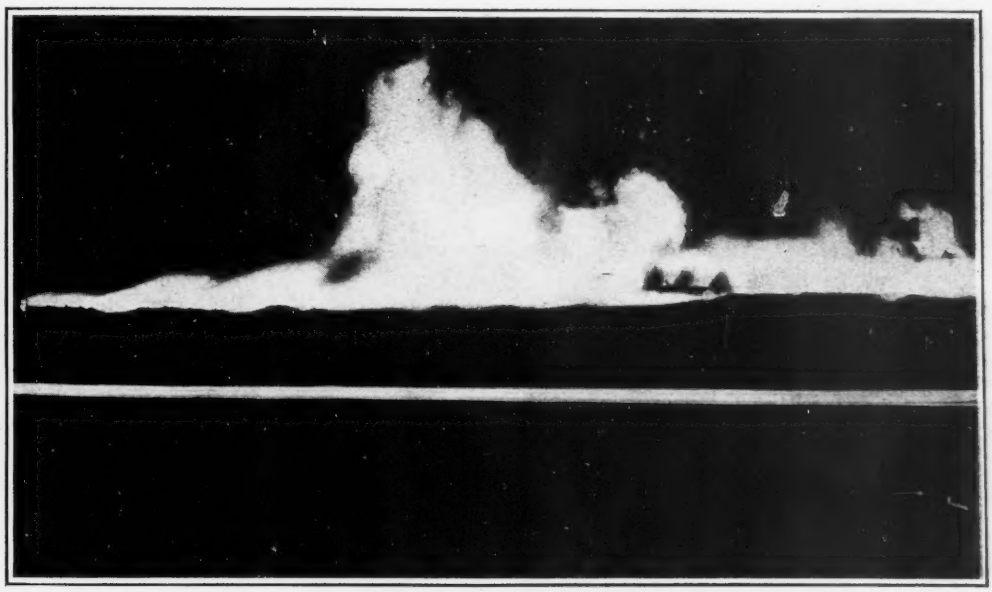
A Fire that Burned Four Months

By A. G. Fasbinder

DURING a violent thunder storm a bolt of lightning struck the oil-soaked ground near the Potrero del Llano No. 4 oil well near Tampico, Mexico, the greatest oil well in the world. For more than four months from that date, August fourteenth, 1914, the resulting conflagration resisted all efforts to subdue it. The flames, covering an area of more than a city block, swept over the mouth of the great well, but thanks to the concrete cap covering the orifice, the main body of oil did not ignite.

Upon the first outbreak of the flames, it was thought that the main well was doomed, as well as a great lake of oil containing nearly two million barrels, which was situated nearby. Twenty-five hundred men were summoned to the work of fighting the flames, and apparatus which had been successfully used at other fires of the same nature was brought to the spot. This great force of workmen labored ceaselessly day and night until the fire was conquered, four months later.

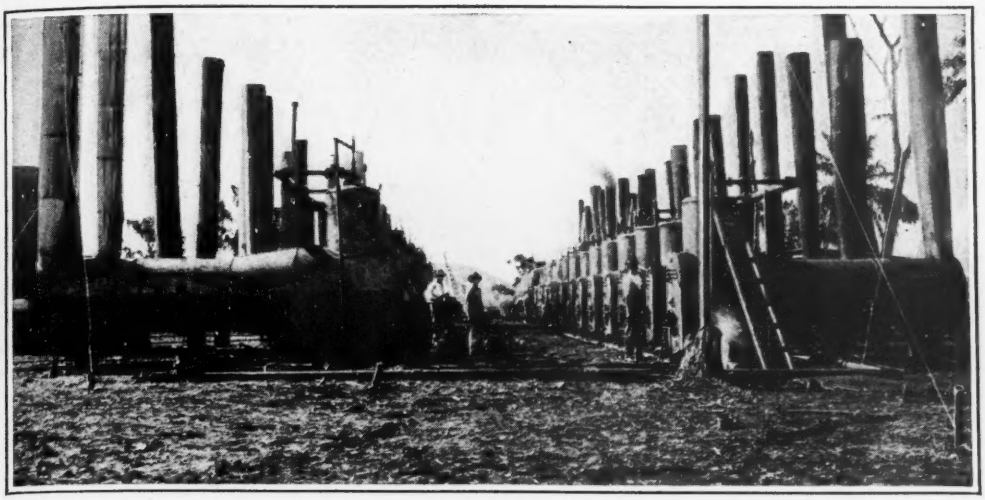
The first precaution against the spread of the flames was the erection of a retaining wall of sand and dirt



The fire mounted hundreds of feet into the air, and at night the huge red canopy over the sky drew thousands of spectators to the scene

A Parapet of Sand to Check the Flames

The first precaution against the spread of the flames was the erection of a retaining wall of sand and dirt which completely surrounded the burning area. The earth itself seemed ablaze, for the oil continued to seep through the soaked ground and furnished new fuel for the flames. Twenty-five hundred men and thousands of dollars worth of equipment were employed during the four months



The battery of fifty-three steam boilers, which pumped immense clouds of steam in a vain endeavor to smother the seething flames

which completely encircled the burning area. The earth itself seemed ablaze for the oil continued to seep through the soaked ground and furnished new fuel for the flames. The fire mounted hundreds of feet into the air, and at night a red canopy covered the sky, visible for many miles. Thousands of spectators watched the work.

A great battery of steam boilers arrived at the spot and pipes were led to the fire. The laborers worked under continuous streams of water from fire hose, for the heat was so great that without soaking themselves in water, their clothing would have burst into flames. Those playing the streams upon the workers had to direct the hose while crouching behind shields to protect themselves from the heat.

When the steam pipes were laid, the battery of boilers was fired up, and clouds of steam descended upon the fire. The effort was vain, for the area of the flames was too great for the steam to cover in order to smother the blaze. More boilers arrived until forty-three were coupled to the steam-pipes. These had no effect, however, so this method was temporarily abandoned.

A shaft was sunk into the ground, and it was hoped to fight the fire through this shaft with the aid of chemicals. This, too, proved unavailing. Spur tracks were laid from the main roalroad lines in order to rush materials more quickly to the scene. Experts were summoned from other mining and oil properties to aid in the work.

Weeks lengthened into months, and still the fire burned fiercely. Much to the surprise of experts the great well, although in the center of the conflagration, did not add its huge flow of oil to the blaze. The concrete cap withstood the intense heat and protected the main quantity of oil. One of the most remarkable features of the fire was the fact that during the time that the fire was burning, the managers were able to draw twenty-five barrels of oil daily from the well through the main flow line from the gate valve, which was well protected by concrete.

The mass of equipment that was brought to subdue the fire was truly enormous. During the four and one-half months that the fire raged, there were used forty-nine boilers of approximately fifty horsepower, twenty steam pumps, three air compressors, two centrifugal pumps, quantities of railroad tracks and ties, road building materials, tens of thousands of feet of steam pipes, etc., all of which took about three thousand men to install.

After attempting nearly every known method of subduing the flames, the engineers in charge set the labor-

ers at work gradually pushing the retaining walls in toward the center of the blaze. Because of the intense heat this was done under the greatest difficulty. The circumference of the wall was gradually tightened, thus slowly reducing the area of the blaze.

Pipes were led to the bottom of the blazing area and oil was drawn as fast as possible from the seepage. As it was not fit for commercial use this was pumped to a safe spot nearly five miles distant from the blaze proper and then burned, making in itself a huge conflagration.

Finally during the last part of December, the five walls had been pushed in so far that the blaze was confined to a relatively small area, and everything was made ready for a last effort, greater than all previous attempts. Tons of chemicals were piled near the scene, and thousands of feet of extra steam pipes were laid from the boilers and pumps. This work lasted until about the first of January. In the first days of the new year, the attempt was made. Chemicals were heaped into the fire area and boilers and pumps poured a deluge of water and steam upon the stubborn flames. For hours this frenzied work continued, the result trembling in the balance. At last the ingenuity of man conquered the stubborn forces of nature, and the fire was out.

It seemed almost hopeless to attempt to calculate the damage done by that bolt of lightning. The estimated production of the great well was one hundred and fifty thousand barrels of high grade oil a day, yet for more than four months but twenty-five thousand barrels were drawn. Thousands of dollars were expended upon equipment for the fire fighters, and other thousands went for chemicals which were fed to the flames.

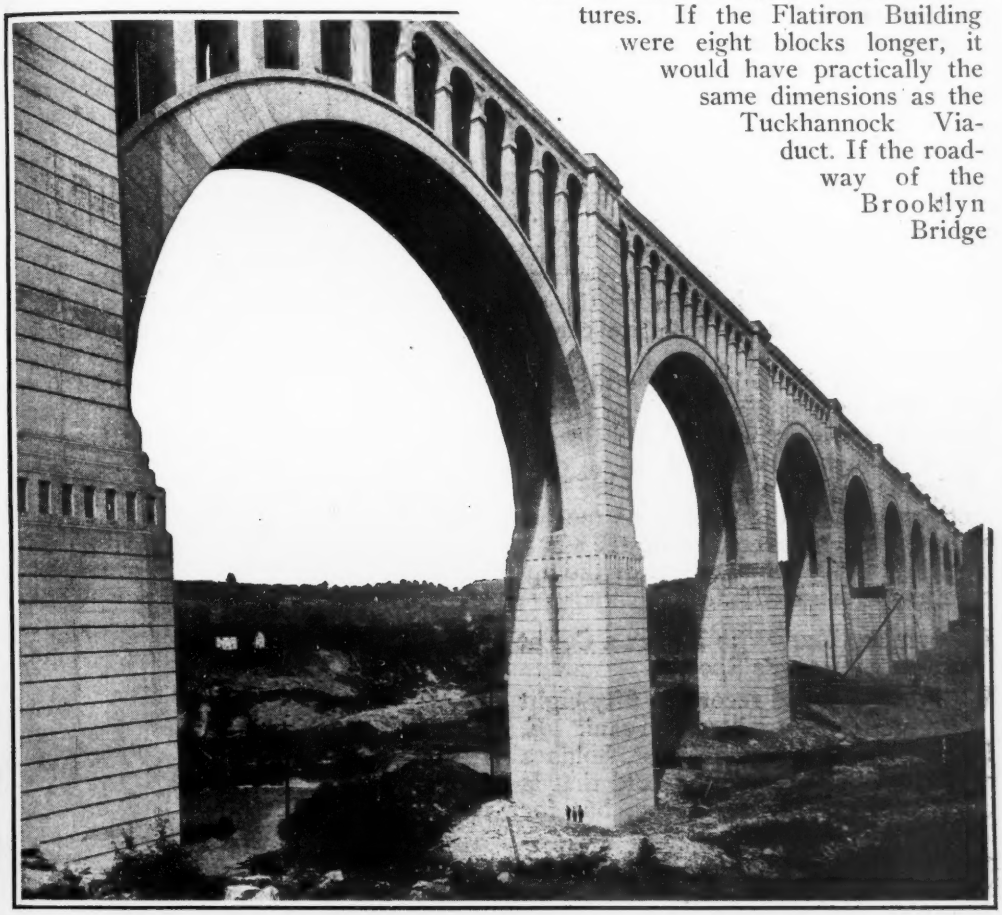
The fire was watched by the greatest interest by the oil trade of the world, who recalled another record-breaking fire which occurred several years ago not far from the Potrero del Llano conflagration. The Dos Bocas gusher, one of the largest in the world at that time, caught fire before being capped. For nearly a year the fire raged, and only subsided when it had consumed all the oil in the fertile pocket which it had tapped. At the present time it produces only salt water and gas.

Pushing in the retaining wall which finally conquered the flames. The heat was so intense that streams of water had to be continually played over the workers, all of them Mexican peons, who are perhaps the most sensitive of human beings to extremes of heat and cold—except in their horn-like nether extremities, which were not affected in this case

Twelve Million Dollars for Twenty Minutes Train Time

TO cut twenty minutes from the running time of passenger trains and one hour from the running time of freight trains between New York and Buffalo, the Lackawanna Railroad has invested twelve million dollars in a concrete arch half a mile long.

structure crossing the Tuckhannock Valley in ten graceful arches. It is of concrete, the largest concrete structure in the world, containing more than five hundred million cubic yards of material. Some idea of its vast size can be gained by a comparison with the dimensions of better known structures. If the Flatiron Building were eight blocks longer, it would have practically the same dimensions as the Tuckhannock Viaduct. If the roadway of the Brooklyn Bridge



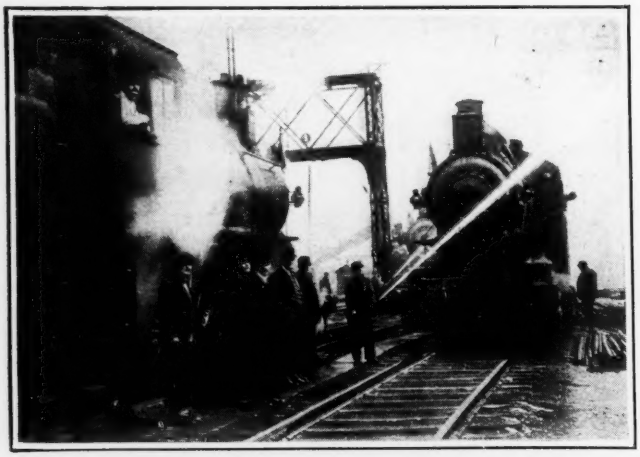
This beautiful viaduct built of concrete, cuts twenty minutes from the train time of the Lackawanna between New York and Buffalo, but it also saves miles of heavy grades

By the old, circuitous route, due to the heavy grades, five engines were required for the work that two can now do comfortably.

The new viaduct is an imposing

were one hundred feet higher, it would have the dimensions of the viaduct.

Including the viaduct, the total length of the cutoff is three and one-half miles. The old route is thirty-nine miles.



The yard locomotive's great and mobile power is now turned to the task of fire fighting

Locomotives Serve as Fire Engines

ONE of the large Eastern railroads has protected its property against fire by equipping all of its yard locomotives with special fire fighting apparatus. Pumps have been installed on the engines, and lengths of hose are carried in the tender.

Each yard is divided into districts, and when a fire is discovered the nearest switch tower is notified and whistles are blown throughout the yard. By a code of signals engineers of fire fighting locomotives are told the location of the fire and are given an open track to the scene. The illustration shows a test of the apparatus on the yard engine.

An Armless Man Who Drives a Car at Racer's Speed

WITH a speed record of fifty-eight miles an hour, Frank E. Fithen, the armless motorist, holds a record in the automobile world that is unique. Not only for speed, but for long distance driving he has made a name for himself, as he has been touring the country for three years and has travelled eighty-five thousand miles. He is now preparing to visit the Northwest, and when he has passed through Oregon, Washington, Idaho and Montana, he will have entered every state in the union, driving his own car. This is a six cylinder machine, long and heavy, and of sixty horse-power.

Mr. Fithen has a few changes made in order to adapt his car to a driver without arms. The most important is the design of the steering wheel, which has a number of metal circles within the wooden rim, and these are just large enough to receive the stumps of his arms. With wonderful agility he can swing the wheel, and also manipulate the throttle, although only a few inches remain of each arm. In addition to the pedals, Mr. Fithen operates the emergency brake with his foot, shoving forward and pulling back the lever with a vigorous motion.

The accident which deprived him of both arms occurred when he was only nine years old, but instead of leaving him helpless, it developed his determination to succeed in spite of his infirmity. Mr. Fithen can dress himself and undress; he can take a pencil between his teeth and write with little difficulty; he can swim, ride a bicycle and perform feats of fancy riding and balancing on the single wheel.

An armless man's own inventions have made it possible for him to drive his motor car at top speed with perfect control

This driver need not lean out to signal an off-side turn. The artificial hand saves him that trouble

Imitation Hand Signals a Turn

AN imitation hand has been devised by a California merchant to warn traffic that his automobile is about to make an off-side turn. It is attached to one of the rods supporting the top. On the rear of the top side of the hand is an eye, to which a string is attached. Whenever the driver wishes to turn a left-hand corner he pulls the string and the hand goes up.

This device costs less than ten cents and obviates the danger of losing control of the steering wheel. The arm is painted black and the hand white.

Sea Shells for Decorating Concrete

A CONCRETE worker of Long Beach, Calif., has discovered a new use for sea shells. The accompanying illustration shows an interesting specimen of his work. It is a garden ornament constructed of solid concrete, decorated with small mussel shells. The shells, arranged in rows and squares, are imbedded in the concrete with the inside of the delicately colored shell exposed. The structure is intended to enclose a bed of flowers, and vines will be trained over the top. The same design may also be employed to surround a garden fountain.

Shells make concrete decorative in detail as well as in line

A locomotive that goes to Fairyland

The "Back Yard Limited"

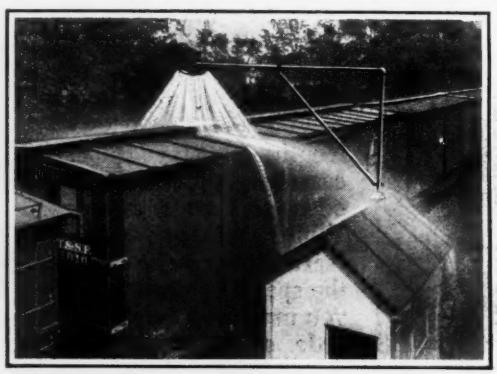
A LOCOMOTIVE was built recently by inventive youngsters. It was composed of the following parts: One barrel, two lengths of stove pipe, one soap box, tin cans and some odds and ends of lumber. While it is not capable of tearing across the prairies at the speed of a mile a minute, you must be a small boy or a little sister to imagine its possibilities. Straw smudge provides the indispensable smoke.

Sidewalk Shelters for the Trolley Patrons of Cincinnati

SIDEWALK shelters for trolley patrons are to be built at the junctions of the principal trolley lines in the city of Cincinati, Ohio. One of these structures has already been erected at a point where ninety per cent. of the trolley cars of the city pass. The innovation has received such general approval that the experiment is to be extended. Smaller sheds are to be built at several other points where trolley patrons congregate to board the cars.

Cincinnati protects her street car patrons from rain and from sun

The shelters are of metal of the umbrella or mushroom type, the characteristic of which is that the supports are in the middle of the shelter where the least number are required, so that little or no obstruction to the stream of pedestrians is offered.



This railroad does not wait for a damage suit to learn whether or not a car roof leaks

Edison's Phonograph Diaphragm to Record Only Faint Sounds

THOMAS A. EDISON has recently been granted a patent on a phonograph diaphragm which will record only faint sounds, excluding those of any great intensity. Cork or a similar material is used. Faint sounds cause the diaphragm to vibrate only slightly; greater vibrations, caused by loud sounds, are restricted by a small cylinder and plunger working on the principle of a solenoid.

Artificial Rainstorm Tests Car Roofs

AN artificial rain storm has been devised by Charles N. Swanson, superintendent of car shops of the Atchison, Topeka and Santa Fe Railroad, as a means of testing the roofs of new cars and repaired cars before they have been put into service to make sure they are rain proof. The apparatus consists of a spraying device which throws a very large quantity of water controlled from a little house at the side of the tracks. The cars to be tested are hauled under the spray twice. The cars are then entered by the inspectors and all evidences of leakage are chalked for the guidance of the repair men. When the cars have been through the repair shops they are again subjected to the rainstorm test before they are put into service. The volume of water is so great that it is possible to locate leaks in the side sheathing or ends of the cars.

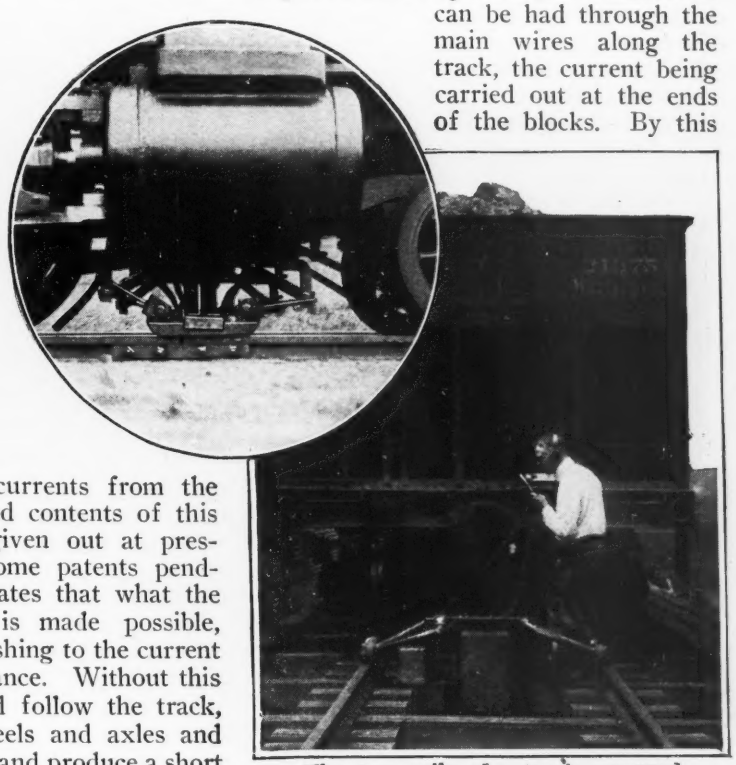
Telephoning from a Moving Train

BY means of the moving train telephone invented by A. A. Macfarlane, communication between fast moving trains may now be possible. Communication has actually been held between the experimental station and New York city. In this experiment the rails of the track were used for part of the conducting medium.

On a sidetrack near the little town of Bridesburg, Pa., experimental work has been carried on with a steel freight car. At one end of the section of track used, a two-volt battery is connected; at the other end a signaling and telephoning device is located between the tracks. The equipment consisted of a "puzzle" box and copper shoes that pick up currents from the rails. The nature and contents of this box are not being given out at present on account of some patents pending. The inventor states that what the device accomplishes is made possible, however, by his furnishing to the current a path of least resistance. Without this device, current would follow the track, run through the wheels and axles and jump to the other rail and produce a short circuit. The current simply avoids its natural outlet, follows the track until it reaches the box and shoes, where it is picked up and taken aboard the train.

Telephoning between moving trains is but a part of the importance of the invention. The real object is to produce a signaling system that will bring the danger and clear signals into the cab of the engineer. An automatic brake has also been added and tested on an engine. The device will light colored lights in the cab of the engine, as well as furnish an automatically operated block for approaching trains. Into each block current will be furnished by batteries along the track. When a train is in this block, it will short circuit the current, so that a train approaching will be automatically stopped by the brake device operated in connection with the system.

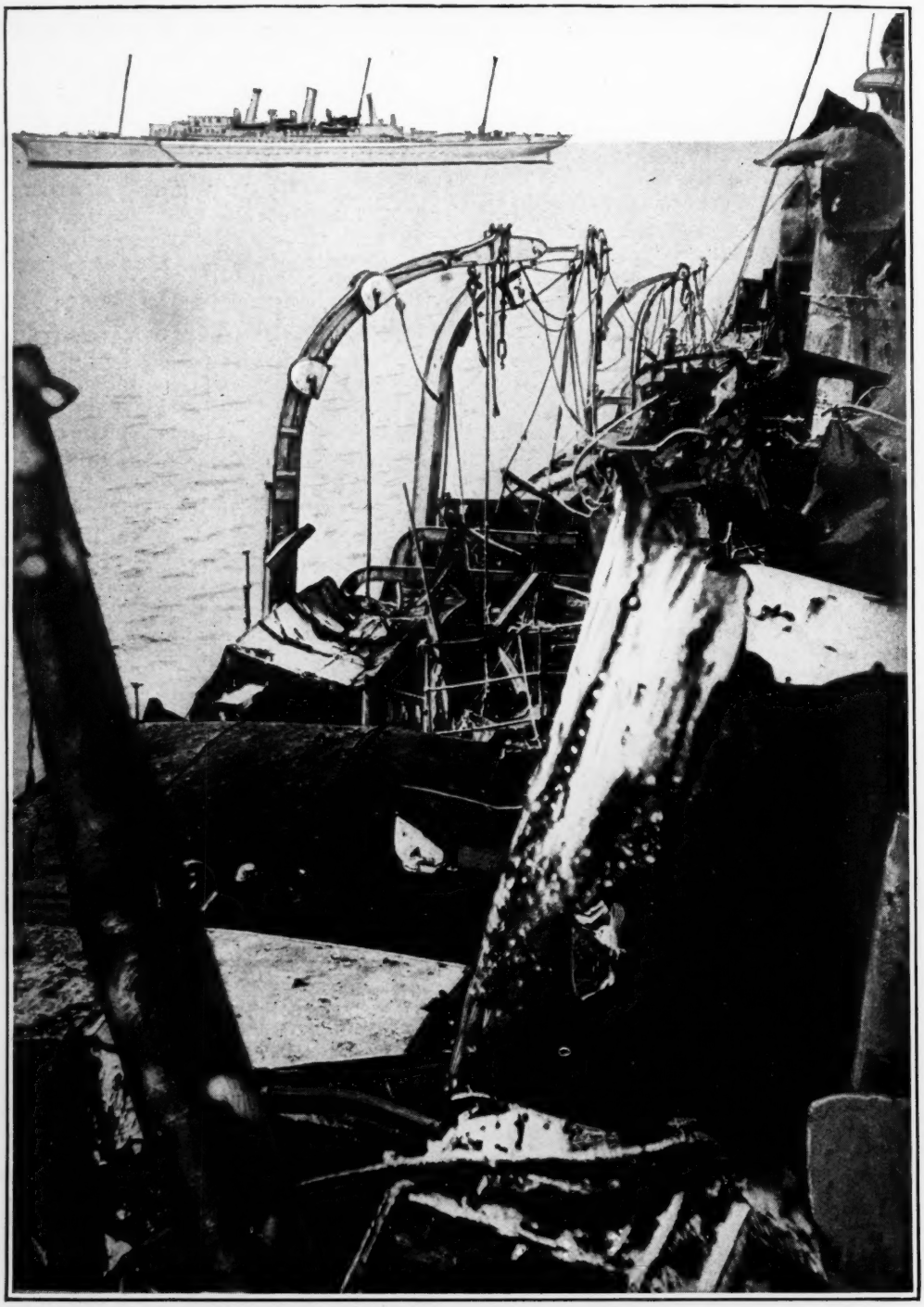
In the telephone system it will be necessary to have batteries along the track, and by the use of the shoes and box device with which the train will be equipped current will be furnished it. Then the telephone can be operated, and connection can be had through the main wires along the track, the current being carried out at the ends of the blocks. By this system, the inventor claims a moving train can be in communication with any telephone in the country.



The two rails of a track are used as wires for telephoning to moving trains. In the circle is shown the shoe by which the connection is made from rail to locomotive

Lengthens Life of Rubber Gloves

A NEW process for vulcanizing seamless rubber gloves has been brought out by which the life of the gloves is said to be considerably lengthened. Instead of vulcanizing the glove on the dipping frame after the several coatings have been applied, each consecutive layer is vulcanized as the glove structure progresses.



The Emden After the Battle—Mere Scrap Iron

The German commerce destroyer Emden was reduced to a mere hulk at a range of two and a half miles by the Australian cruiser Sydney. Part of the Emden's crew were on shore and later reached Europe after many wild adventures in tropical lands

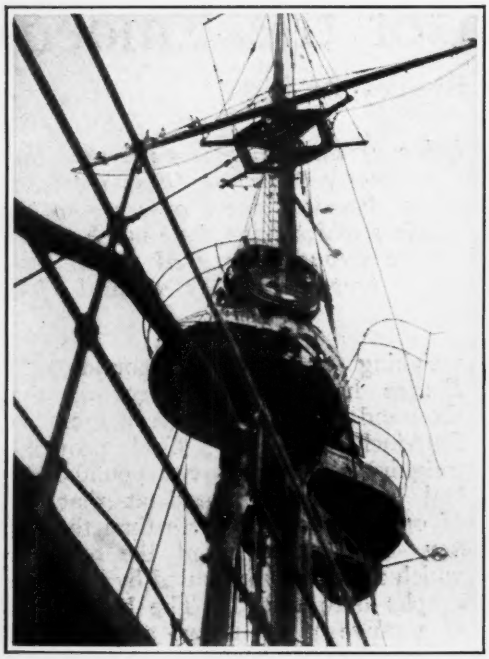
The Destruction of the Emden

By Rear-Admiral Bradley A. Fiske

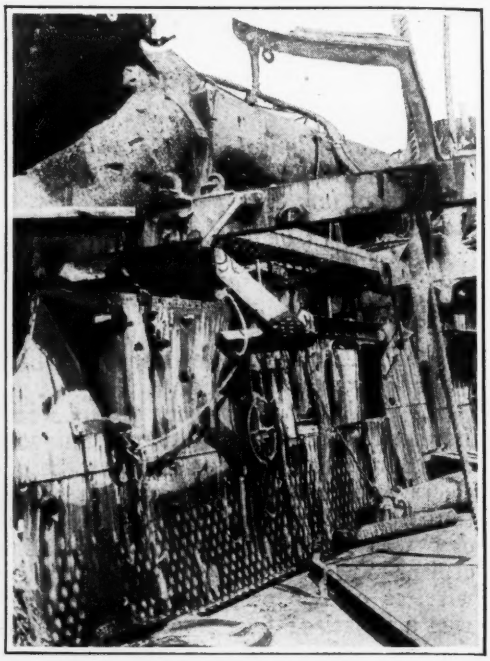
Rear-Admiral Fiske's graphic description of the battle between the Australian cruiser "Sydney" and the German commerce destroyer "Emden," is all the more interesting because it comes from an American naval officer who has distinguished himself by the invention of devices which have done much to improve American gunnery. The frightful havoc wrought by shell fire on the doomed German ship carries with it a lesson in preparedness, as Admiral Fiske points out.—Editor.

WHEN making her last raid, which was against South Keeling, an island of the Cocos group, a few hundred miles southwest of Sumatra and Borneo, and while she had three officers and forty enlisted men on shore, the German commerce-destroyed *Emden* was surprised by the Australian cruiser *Sydney* that had been told by wireless of her presence. The *Sydney* was a vessel of five thousand two hundred tons displacement, had a maximum speed of twenty-six knots and carried eight six-inch guns that fired projectiles weighing one hundred pounds. The *Emden* had a displacement of three thousand six hundred tons, mounted ten four-inch guns that fired projectiles weighing about thirty-two pounds. She had a maximum speed at that time of one or two knots less than the *Sydney*. An action ensued, the results of which are clearly indicated by the photographs here shown. The battle began at a range of about two and a quarter miles; but the range was quickly increased by the *Sydney* whose Captain took advantage of her superior speed

All that is left of the bridge from which the captain and officers were wont to direct the activities of the fast German commerce-destroyer Emden



The bridge reduced by the Sydney's shell fire to a battered wreck



The spar deck of the Emden was torn up by a veritable hail of shell

to secure a distant position, at which the smaller guns of the *Emden* could do the *Sydney* very little harm.

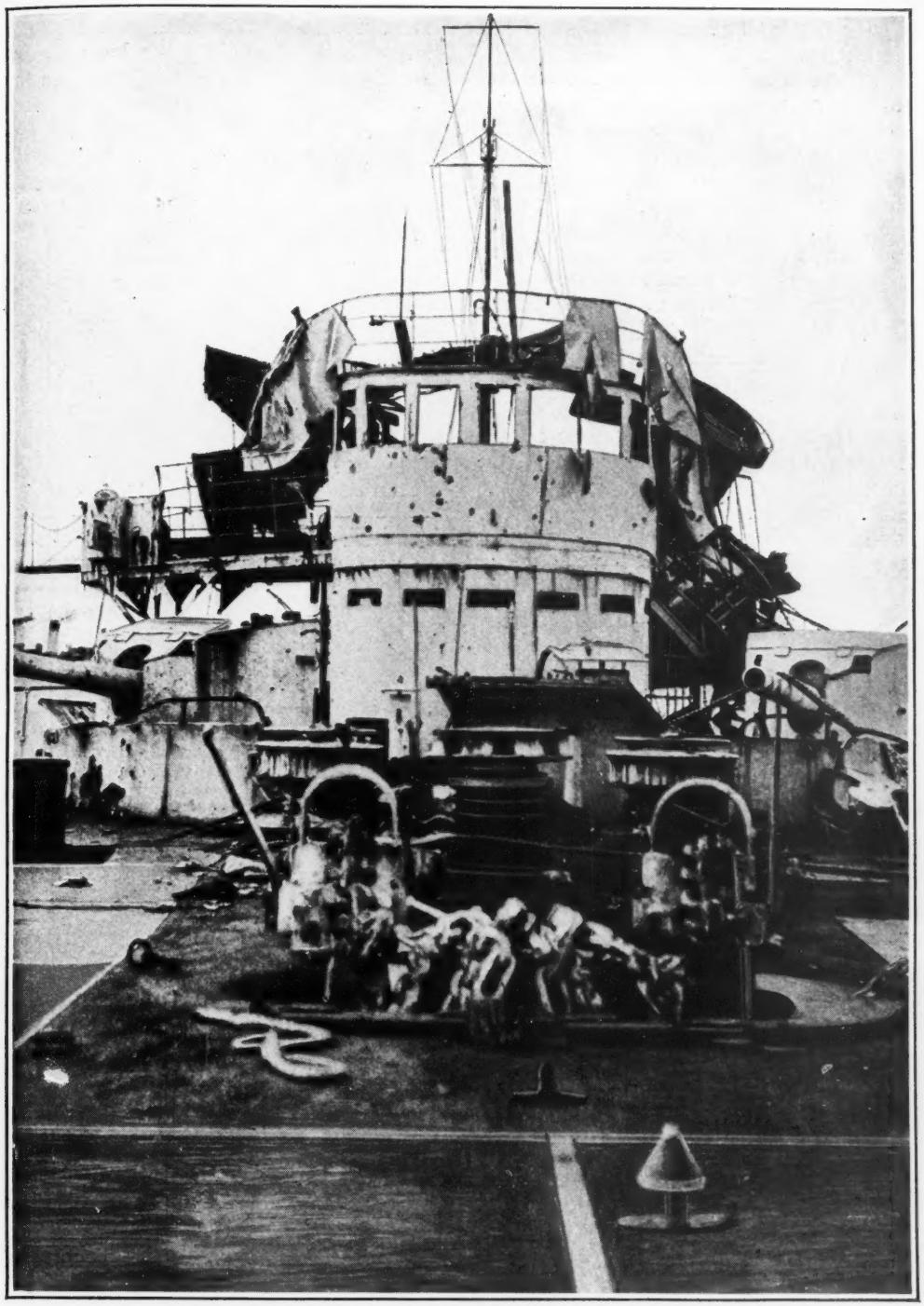
Steel Crumpled Like Paper

These photographs indicate the frightful effect of naval gunnery and suggest the tremendousness of naval power. In naval ships, large guns are installed that can be taken at great speed all over the world, and fired with great precision over long distances, and with great effect. In the photographs, we see great masses of steel, crumpled like paper; we see the ship's side penetrated; we see the bridge from which the Captain and the officers usually directed the ship, an undistinguishable wreck of iron and brass; we see the funnels made veritable scrap-iron; we see the spar-deck torn up; we see the ship itself reduced from the condition of a rapidly cruising man-of-war to that of an inert mass of torn and twisted iron. All this was done in little more than an hour.

Although the *Emden* was not a very powerful ship compared with many others she was nevertheless a strong and well-built vessel, and could not have been wrecked except by tremendous power. The power of armies is exerted for the most part by muskets, which cannot be heavier than single men can carry and by field artillery and siege artillery, intended for use against men and lightly constructed buildings of wood and stone and brick.

A Fourteen-Inch Shell is Equivalent to Sixty Thousand Muskets

The value of a bullet fired from a musket, or of a large projectile fired from a gun, is due to its ability to penetrate the resisting envelope of a man in one case, or a ship in the other case. Naturally, the measure of that power is the energy of the projectile, which energy is dependent on both mass and velocity. As was shown in the November number of the POPULAR SCIENCE MONTHLY, the energy of a fourteen-inch shell fired say from our *Nevada*, is about equal to that of sixty thousand muskets when the projectiles start. But after the musket bullet has gone a little more than a mile, it falls to the earth, its energy reduced to zero, while the fourteen-inch projectile has hardly started. If the *Emden* had been fired at by muskets at the dis-



The Work of an Hour and a Half

It takes tremendous power to destroy a ship of war, as Admiral Fiske points out in his article. If the Emden had been fired at by muskets from the distance at which the Sydney destroyed her, the bullets, if they reached their mark, would have rattled off harmlessly

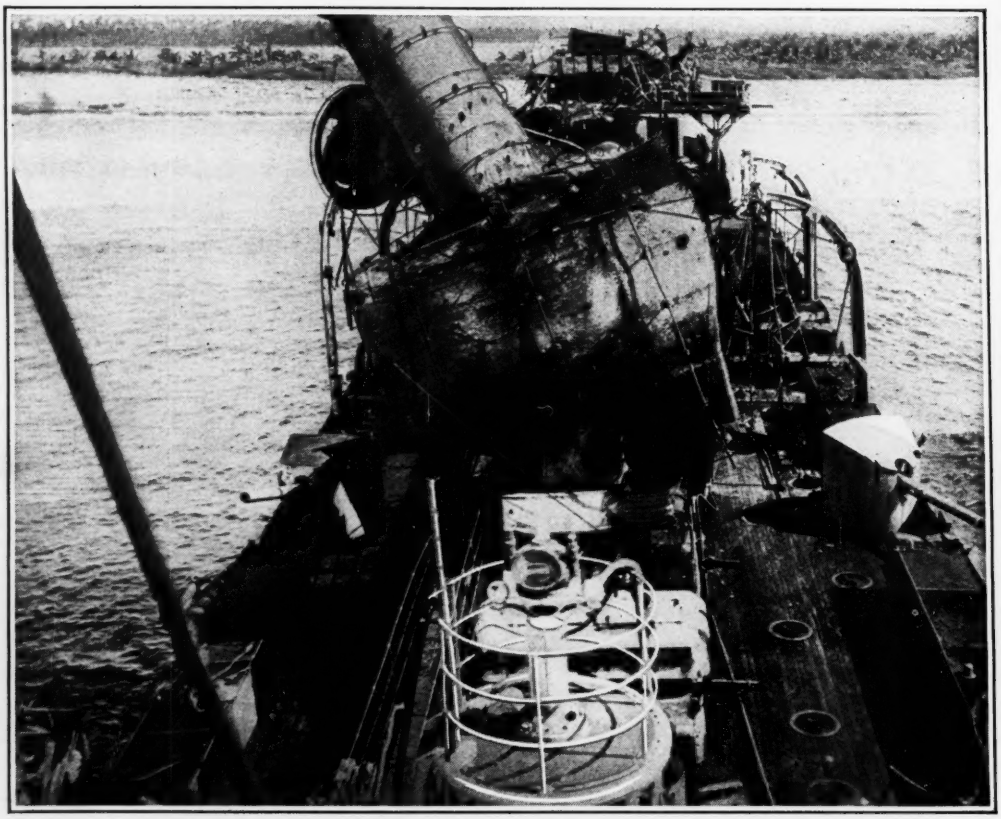
tance at which the large guns were fired in the battle the bullets would not have reached her.

It would not be possible for an army to carry around on land by any means whatever the big guns of war ships; so that the curious condition has come about that the dangerous sea, which defied for centuries the ability of man to move upon it, except very slowly and over little distances, is now contributing much more than the land to the exercise of his power.

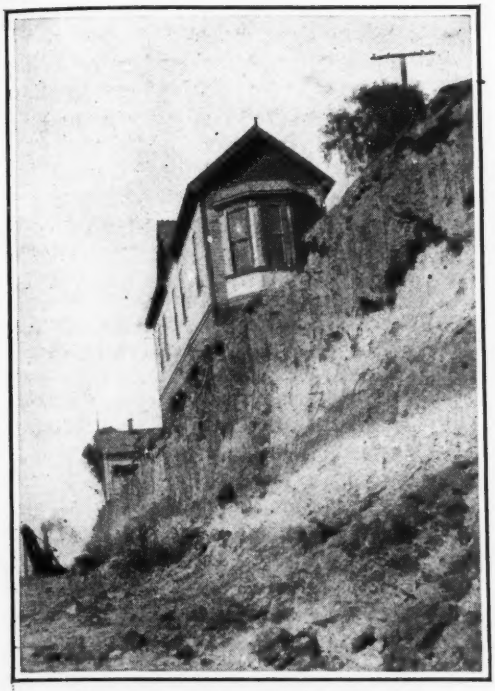
Suppose New York Had been the Target

The destruction wrought upon the *Emden,* of which these photographs give such gruesome proof, has another interest for us, of a character not philosophic, but eminently practical, because it suggests that if this damage could be done to a strong, steel structure, like the *Emden,* what would have happened to buildings, in New York, if they had been the targets instead. And it also suggests what might have been the effect if those buildings had been the targets not of the comparatively small projectiles which were fired at the *Emden,* but of fourteen-inch projectiles weighing fourteen hundred pounds, filled with high explosive, fired from a hostile ship.

The American fleet having been defeated, a single ship carrying guns able to fire projectiles fifteen miles, and protected against submarines by numerous destroyers and by other means, could, in two or three hours, fire into New York from a point beyond the reach of any of our guns, one hundred high explosive shells, which falling on our streets, power stations, subways, elevated railroads and skyscrapers, would make the vicinity of Wall street look like these pictures of the *Emden.*



In these battered funnels and this riddled deck we see the price of slowness; for the triumphant Australian cruiser Sydney was just a little faster than the Emden, whose bottom had been fouled by long cruising in tropical waters



The house rests on the brink of a city improvement, and also on the brink of destruction

An Excavation for a Road Leaves House on Brink

IN San Pedro, Calif., a "good road" boulevard is being cut through a hill. The accompanying photograph shows a house that has been left on the very brink of the excavation, and in a precarious position. The steam shovel can be seen in the background scooping deeper. The ground is an old sea-beach made up of loose sand. The owner has threatened to sue the city should the house come to harm.

Women in Europe's Machine Shops

THE tremendous demand upon the ranks of skilled workmen since the war has resulted in the surprising knowledge that women can supplant men in machine shops.

That the woman mechanic has adequately risen to her opportunity is a fact heartily attested to by scores of European manufacturers. Several of them who have made a systematized study of the woman workman's progress claim that the untried women mechanics have mastered the details of their tasks in a much shorter time than workmen require.

Another interesting point is that the traditional belief of woman's inability to invent is quite unfounded. As an example, in one machine shop where men had been employed on a certain operation for years women took up the work, and in less than a week had devised a plan whereby the time required for the operation was halved.

Shipping Pigs in Baskets.

THE lot of domestic animals in the east is not enviable, particularly when enduring transport from one place to another. Fowls are always sent to market with their legs tied, so that it is impossible for them to move. The photograph shows how live pigs are transported in the Straits Settlement by steamer or barge. They are shipped singly in wicker work baskets. The receptacle is just large enough to take a single pig. In this cramped and uncomfortable position, for the animal's legs are tied, making it nothing more than a living log, it is often shipped long distances. Water is thrown over the animals and occasionally they are allowed to drink, but nothing is given them to eat.

They know nothing of "pigs in blankets" in the Orient, but pigs in baskets are a common sight

Selling by Show-Window Telephone

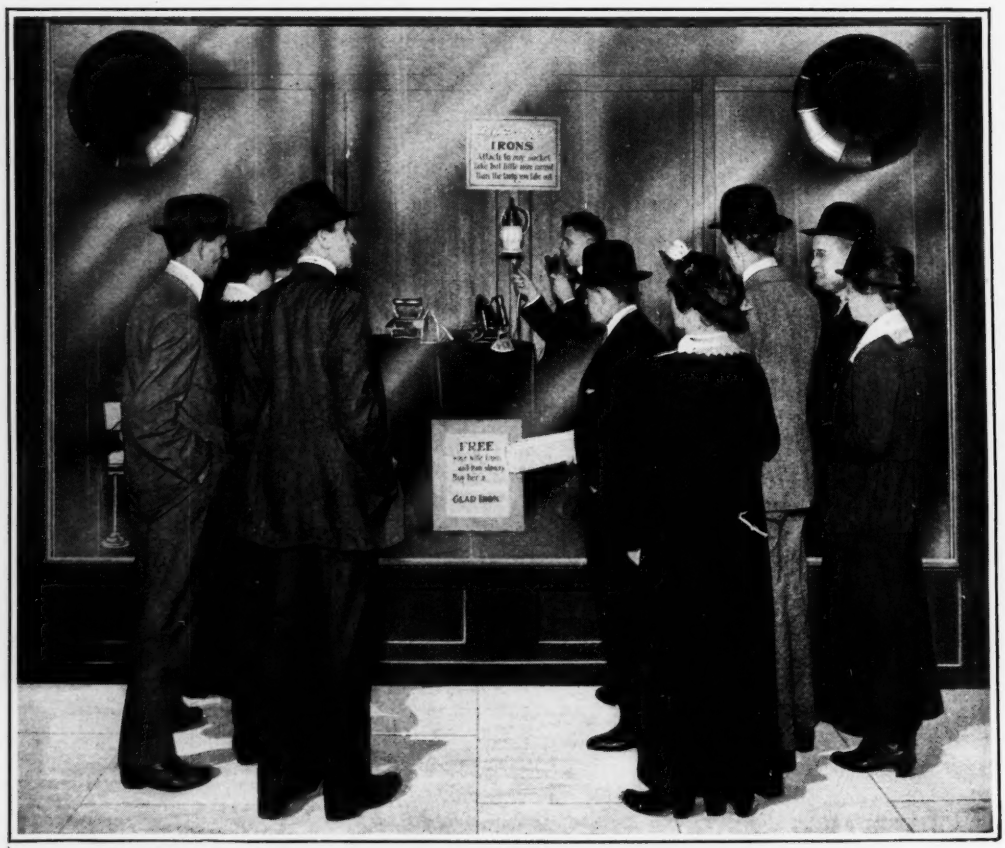
THE drawback to window demonstration of any character is the inability of the demonstrator to get his "message across." He can clearly point out the talking points of the article under demonstration, but he can talk about it through the medium of lettered cards only. It is obvious that this method is very unsatisfactory. To overcome the objection and bring the demonstrator nearer his audience, an electric company has developed a loud speaking telephone equipment.

The equipment consists of a special transmitter and a pair of loud speaking receivers and horns. The operation of the system is simple. The demonstrator connects the horns and receivers on both sides of his window, just high enough to be outside the reach of mischievous youngsters. The transmitter is placed inside the window and is wired with the battery of six dry cells in series.

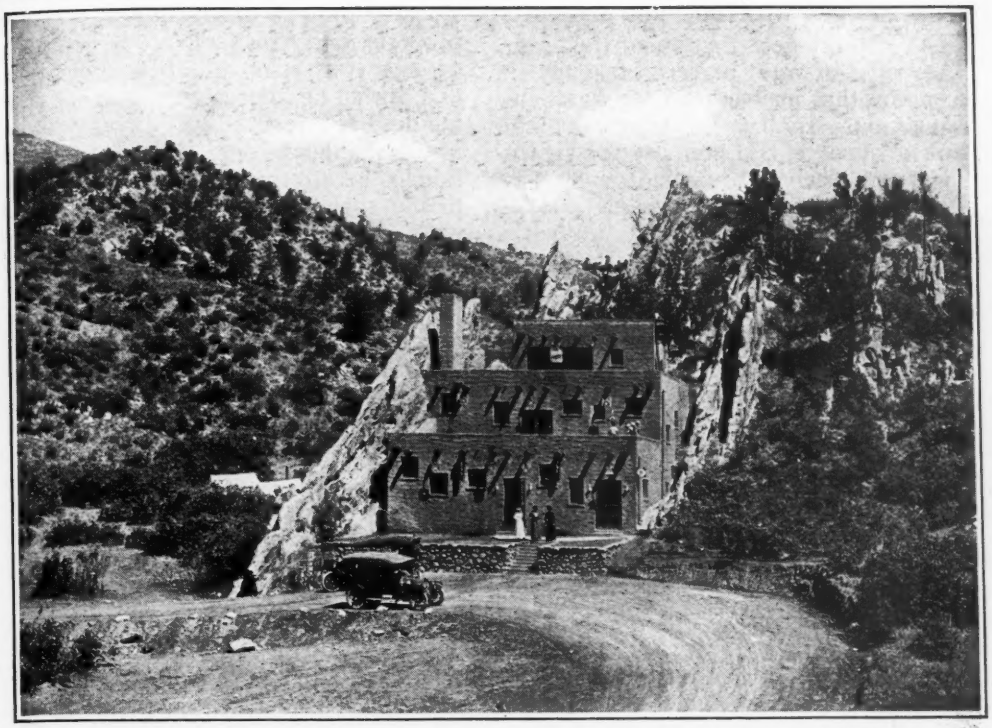
As the demonstrator wishes to bring out each point, he simply speaks into the transmitter and his voice is magnified by the receivers and horns and carried to the audience outside. The equipment not only brings the demonstrator and his audience into more intimate contact, but serves as an auxiliary attraction to the display itself. It has proven a success wherever used.

Oil is Cheaper than Coal

TWO large steamships, the *Finland* and the *Kroonland,* will be changed from coal to oil burners. By this change it is expected that $9,000 will be saved on fuel and $3,500 in wages on each trip. In addition, by the large space now occupied, coal may be used for the storage of freight. A total saving of $37,500 is expected on each trip.



The window salesman need no longer resort to cards and dumb-show. By means of a loud-speaking telephone he talks to his audience on the sidewalk



The new rest-house at the entrance of the Garden of the Gods near Colorado Springs is built after the style of a Pueblo village, in keeping with the primeval magnificence of the park and its traditions

A Pueblo Village for the Garden of the Gods

BUILT in the architectural style used by the Pueblo Indians of the Southwest, a novel rest house has been erected by the Colorado Springs Park Commission just within the gateway of the Garden of the Gods.

This magnificent park now has a structure in keeping with its surroundings and its traditions, as the appearance of the building harmonizes in its rugged lines with the rocky backgrounds, while the color, of a reddish tone, also corresponds with the hue of the cliffs and boulders. The terraced effect of the building is borrowed directly from the community houses such as are found in Taos and a few other primitive native towns, built in similar craggy places.

Monument Built to an Apple Tree

PERHAPS one of the most curious monuments in existence has recently been built in Ontario by Canadians. The farmers have just erected a marble pillar to mark the site on which grew a famous apple tree.

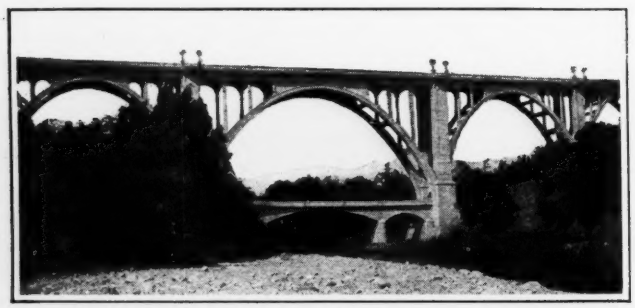
More than a century ago a settler in Canada named McIntosh, when clearing a space in which to make a home in the wilderness, discovered among a number of wild apple trees one which bore fruit so well that he cultivated it and named it McIntosh red.

The apple became famous; seeds and cuttings were distributed to all parts of Canada, so that now the McIntosh red flourishes wherever apples grow in the great Dominion. In 1896, the original tree from which this enormous family sprang was injured by fire; but it continued to bear fruit until five years ago. Then, after fifteen years, it died, and the grateful farmers have raised a marble pillar in honor of the tree which has done so much for the fruit growing industry of their land.

The story of this apple tree illustrates the African proverb that though you can count the apples on one tree, you can never count the trees in one apple.

Two Bridges with but One Approach

TWO bridges that use the same right-of-way present a study in economy that may be seen at Pasadena, California. Both bridges are of reinforced concrete, and both are for vehicular travel, each entirely independent of the other. The small bridge, running lengthwise, is directly underneath the large one, and, in fact, its approach at one end passed through two of the piers of the larger structure.



The bridge that spans this picturesque stream has two rights of way, one for the dwellers on the plateau and one for those of the valley

The large bridge, completed about two years ago, was constructed at the combined expense of the city of Pasadena and the county of Los Angeles. It has a total length of one thousand, four hundred and seventy feet, and is composed of nine spans and six girder spans, besides the usual abutments. From the lowest point in the channel bed to the roadway level it is one hundred and sixty feet in height, and the roadway that traverses it is twenty-eight feet wide, with a five-foot sidewalk on either side. Extending across what is known as the Arroyo Seco, from rim to rim, it spans not only a small mountain stream, but also a lowland of considerable extent, embracing many acres of orange groves and a number of fine homes. It is a feature of a much-traveled automobile road that connects Pasadena with the city of Los Angeles, and is of rather ornate design.

The small bridge, finished only recently, was built at the expense of private property party owners. It is composed of one long span and two short ones, and, including approaches, is about three hundred feet long. Built directly underneath the large one, it is designed to bridge the stream channel only. Owing to the skeleton-like construction of the piers of the great structure overhead, one of its approaches passes through one of these piers, and the roadway leading thereto pierces still another. The purpose of this small bridge, thus located, is to serve the property owners who reside on the level below the rims of the depression, so that they may not be required to make the long and circuitous climb to and from the larger bridge's approaches.

A Vast Tank with a Park on Top

A TWENTY-FIVE MILLION gallon concrete tank which will be hidden from view by being parked over, probably the largest of its kind in the world, has been constructed in Cleveland as a part of the new filtration plant.

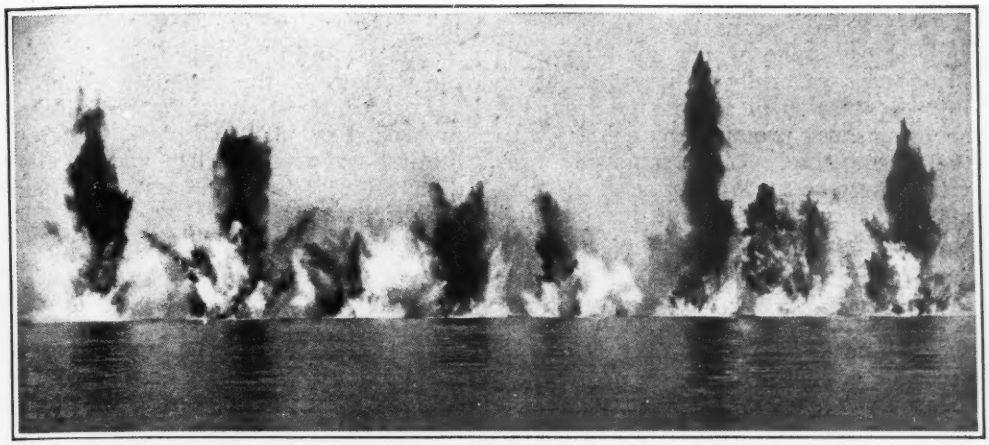
The top of this one hundred and fifty million gallon tank will be a fifteen-acre park

The plant will have a capacity of one hundred and fifty million gallons a day. It covers fifteen acres.

When completed the tank will be covered with earth and become a part of the city park on which the plant is being erected.

The Making of a Submarine Mine

By John Randolph Rexford



A battery of mines electrically exploded. Here is a fiercely graphic illustration of the destructive power which is contained in the comparatively small globe or cylinder of steel whose sowing abroad in the sea is the first duty of the navy and coast defense when war breaks

ORIGINALLY all forms of apparatus designed to explode under water to destroy ships were called torpedoes, but this term is now applied only to the well-known naval weapon. Submarine mines may be divided into three groups:

1. Buoyant mines having a constant depth of immersion.
2. Ground mines which are used in shallow waters and rest on the bottom.
3. Floating mines.

The mines belonging to the first and second groups may be exploded either from land by an electric current or by automatic contact with a ship.

Electrically controlled mines are employed only for the protection of harbors and channels and may be divided into two classes: those which are entirely and those which are partially controlled from land. A mine consists generally of two perfectly watertight metal casings made of suitable shape. One of them is hollow and is intended to act as a float to maintain the mine at the required depth below the surface, while the other one is filled with the charge, which may be guncotton, trinitrotoluene or any other suitable explosive, and the detonator for firing the charge

In coast defense work where electric control is employed, mines are anchored permanently in suitable positions, where hostile vessels are likely to pass over them, and are connected by means of electric cables to the shore. Where mines are entirely controlled from shore, an observer on land can fire any mine or groups of mines by closing the electric circuit the moment his optical instruments inform him that the enemy's ship is over a mine.

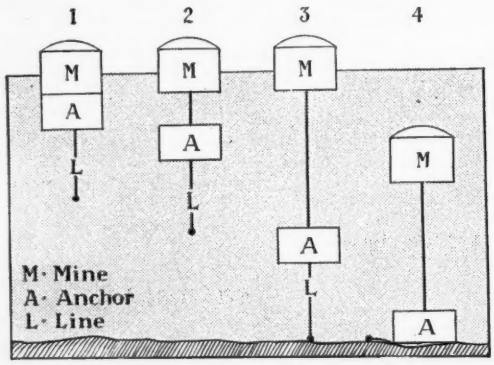
Firing an Electrical Mine

Mines which are partially controlled from land are anchored only a few feet below the surface of the water. When a ship strikes such a mine an electric contact is made which sends a signal to the shore station. The observer can then decide whether to fire the mine or not. An advantage of electrically controlled mines is that neutral ships can be allowed to pass over such mine fields in perfect safety. The use of such mines has, however, been considerably reduced, chiefly because salt water is one of the greatest enemies of electrical apparatus and makes it very difficult to maintain the electrical connections with the mine, and also because the permanent location

of such mines could be discovered by spies.

The mines which have been chiefly used in the present war are automatic and mechanical, and are fired when the ship strikes against them.

It is by no means easy to design a satisfactory mine which shall have its firing gear carefully adjusted so as to insure explosion of the charge from the slightest shock produced by contact with the passing ship. At the same time provision must be made to prevent the premature firing of the mine either on land, on the mine laying ship, or when being launched into the mine field. Again, it is important that should one or two mines be exploded, the adjacent ones be not fired accidentally—a difficult problem, as the concussion of the water produced by the explosion tends to disturb other mines. Another essential condition is that the depth of immersion under the surface should be constant so far as the rise or fall of tides allows.



Positions assumed by a mine and its automatic anchor in water from the moment of dropping the mine overboard to the final moment of mooring

A mine consists of three parts: (1) the chamber containing the firing mechanism, the detonator and explosive charge: (2) the flotation chamber to give buoyancy to the mine, and (3) a detachable anchoring chamber provided with a winch having a paying out cable.

A mine is maintained at the desired depth in the water by means of an anchor in which the cable, one end of which is connected to the mine, is unwound from a drum suitably braked and mounted in the anchor casing. The rotation of the drum is controlled by a plumb weight attached to a short sounding line. When the plumb weight reaches the bottom of the sea the rotation of the drum is stopped and the mine is pulled down to the required depth. It is only necessary to determine at what depth below the surface it is desired to anchor the mine and to throw into the water the complete apparatus, namely the mine and anchor, whereupon the whole apparatus will take up its proper position, the depth of submersion being determined by the length of the sounding line.

The diagram on this page illustrates the working of the automatic anchor:

Position 1. After having been dropped overboard the mine is at the surface of the sea with its attached anchor immediately below the mine with the plumb weight hanging about nine feet below the anchor.

Position 2. The barrel is unwinding its cable and the anchor is descending to the bottom of the sea owing to the force exerted by the plumb weight in keeping down a lever, so that the drum is free to rotate.

Position 3. The plumb weight reaches the bottom of the sea and the pull exerted on the lever ceases. This lever is now released and locks the drum, so that it cannot pay out any more.

Position 4. As no more cable can be paid out the anchor has sunk to the bottom of the sea and drawn the mine with it. It will be seen from the diagram that the depth of immersion depends on the length of the sounding line.

A safety device is generally introduced which is operated by the pressure of the water. The firing gear is locked by a spring which, however, is counteracted by the pressure of water. When the mine is submerged the firing gear is operative, but as soon as it comes to the surface the water pressure is gone and the mine cannot be fired. The percussion device employed is of the usual type for exploding charges of guncotton and does not differ from those ordinarily used.

The detonator is sharply struck by a ball or a lever when the mine is hit

by the ship and causes the main charge to explode.

In order to make a mine field as effective as possible loose ropes are sometimes connected between different mines with the object of getting the ship's propeller entangled in the rope and thereby drawing the mine towards the ship and exploding it.

Launching a submarine mine

Mines of the type described are easily laid. When stowed away on the deck of a mine-laying ship the mine rests on the anchor which at the same time forms a little carriage to be run along the deck and simply dropped over the stern of the ship at the right moment.

Whether mines have actually been laid by submarines is, of course, known only to the naval authorities. Patents have, however, been taken out within the last few years for specially designed mines to be laid by submarines and also for providing submarine boats with a series of chambers on each side for holding and launching mines. These chambers are disposed between double walls of the submarine and are made to form a smooth outline with the hull of the boat. This provision makes it possible to carry a double cargo.

Mines Which Become Ineffective After a Certain Period

Unanchored automatic or floating mines must be dead in an hour. They are used to some extent in naval battles and are very cheap in construction. In some mines of this type clockwork is used which after an hour throws the firing gear out of action while in another type delay-action devices for opening valves to admit water are employed so that the mine is sunk after a definite time interval.

To some extent chemical methods are employed to fire the charge in floating mines, but a disadvantage is that the explosion does not take place instantaneously as is the case with a mechanically fired mine. A glass tube is attached to the mine which is broken when struck by a ship; water enters and by coming in contact with sodium or potassium fires the charge. Other chemicals such as sulphuric acid have also been used to fire the charges in floating mines.

Loading an American mine. Unanchored automatic or floating mines must be dead in an hour. Various devices are incorporated to obtain this result

A Millinery Store on Water

A RETIRED milliner of Atlantic City, who spends his winters in Florida, bought a boat at Daytona and converted it into a millinery store. The exigencies of the situation made this original store desirable, for buildings are not allowed on the shore side of the street along the beach, and therefore rents are very high on the other side of the street. With his boat scheme he combined home comforts with a fine business location. His boat is seventy feet in length and twenty feet wide, and is lighted inside and out with electricity.

Bonnets for sale on water

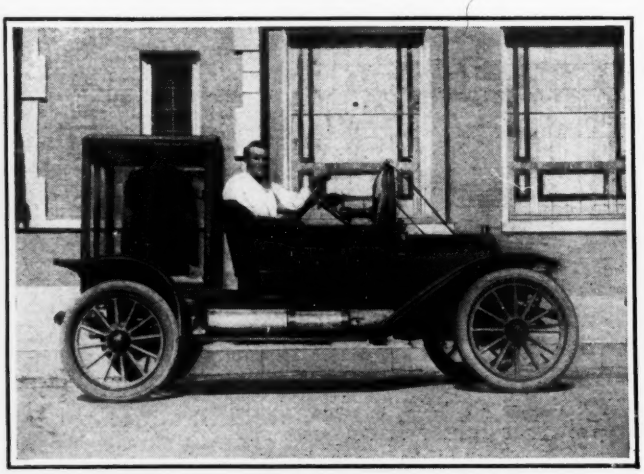
An Automobile Show Case

ONE of the latest features of the business world of Monrovia, Calif., is the delivery outfit devised by the proprietor of a dyeing and cleaning establishment. It has been termed the "show case" delivery outfit. It is built like the ordinary delivery case, but its two sides and back are of glass, so that the suits or cloaks inside may be plainly seen by pedestrians upon the sidewalk or the occupants of passing machines. The coat hangers are hooked over screw-hooks fastened to the roof of the case.

The owner removed the rear seat of his five-passenger car and in its place located the case. Both the case and the rear seat are "quick detachable" and one may be changed for the other in a very few moments. The floor of the case is four feet square, while it is four and a half feet high. As an advertising medium this case shows the people of Monrovia the kind of work turned out by this cleaning establishment, a plan which fits in nicely with this "show me" age.

A Sandstorm to Order

A NEW use for the aeroplane has been recently discovered. A prominent moving picture director was searching for the best method of reproducing a sandstorm on the scenery, and took his company to the government aviation school. The scenery was set up on the sandy grounds surrounding the school, and one of the aeroplanes was held fast and the motor started. When the motor was turned to full speed, the back-wash from the propeller stirred up a real sandstorm over the outdoor stage.

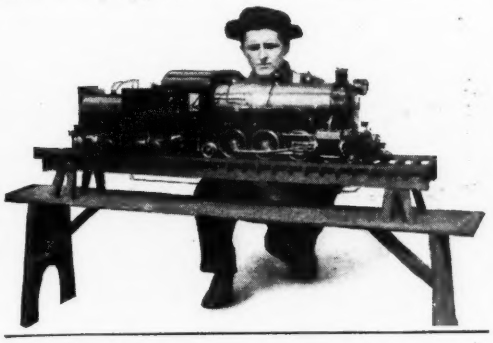


A California dyer displays his work in a glass delivery wagon. He took off the rear seat of his five-passenger car and in its place located the glass case in which was displayed his work on its way home to the customer

A Boy's Wonderful Working Locomotive Model

A MINIATURE railway locomotive, complete in every detail, which has attracted the attention of the railroad officials of several Pacific Coast lines, is the handiwork of Arthur Johnson, of Portland, Ore.

This tiny locomotive, only forty-five inches in length, was built to test a new invention of his on a firebox. It is operated by steam, generated by oil fuel, and is equipped with air brakes, an interior throttle and reverse levers and gears.



A working model of a locomobile, built by this boy, which develops one-quarter horse power and will haul a ton

The engineering department of the Southern Pacific Company borrowed the model and figured out its weight, power, and all other statistics in the same manner that they would figure on a full-size locomotive. To their surprise they found that the tiny engine developed one-quarter horsepower, and on a level track had a haul capacity of one and a quarter tons.

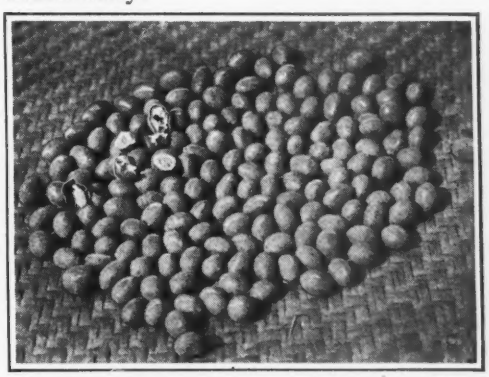
How Savages Prepare Poisoned Arrows

THE savage tribes of interior Africa have attained an extraordinary degree of skill in preparing poisons with which to make their arrow heads the dread of their enemies. Although they use a variety of substances in making the poisonous fluids, such as animal extracts, and products of decay, the most common source of the most violent poisons is found in several species of tropical plants. One of these, the Strophantus, is extensively employed by the tribes of West Africa. They boil the fruits of this plant in water for about twenty-four hours, frequently adding to the liquid heads of serpents, tainted blood and a mixture of dead frogs. When this devilish mixture has cooled to a thick mass, they dip the heads of their arrows into the poison, and then allow them to dry in the sun. They repeat this process every few months so as to retain as much of the deadly effect as possible. The action of these poisons is very violent, death resulting, with intense agony, in five or ten minutes.

Two-Year-Old Eggs.

THE accompanying photograph shows a batch of eggs on sale in the native market at Nanking, China. China like other nations, consumes a large number of eggs, but the Chinese have very extraordinary methods of preserving them, by which they are kept for long periods. Eggs can be found in various inland towns of China that were known to be two to three years old. Like those in the photograph they were almost jet black and very hard, but nevertheless eatable.

When fresh, the eggs are covered in a thin coat of clay or similar mixture and then cooked until they are quite hard. They are then immersed for several hours in water. Treated in this way the eggs may be kept almost indefinitely.



These eggs are two years old—and good

The February Popular Science Monthly will be on sale Saturday, January fifteenth. (West of Denver on Thursday, January twentieth.)

Your Feet Are Wiped When You Enter Bohemian Bakeries

IT is an old custom in Bohemian bakeries to wipe the boots of visitors as they enter. There is a good deal of wiping these days; for the government and city officials inspect the bakeries at very frequent intervals in order to see that the regulations regarding the amount of flour used in bread are carried out.

The picture shows Dr. K. Gross, the burgomaster of Prague and representatives of the city council, entering one of the bakeries of the city. The burgomaster is the man whose boots are being wiped.

How Range Finders Find the Range

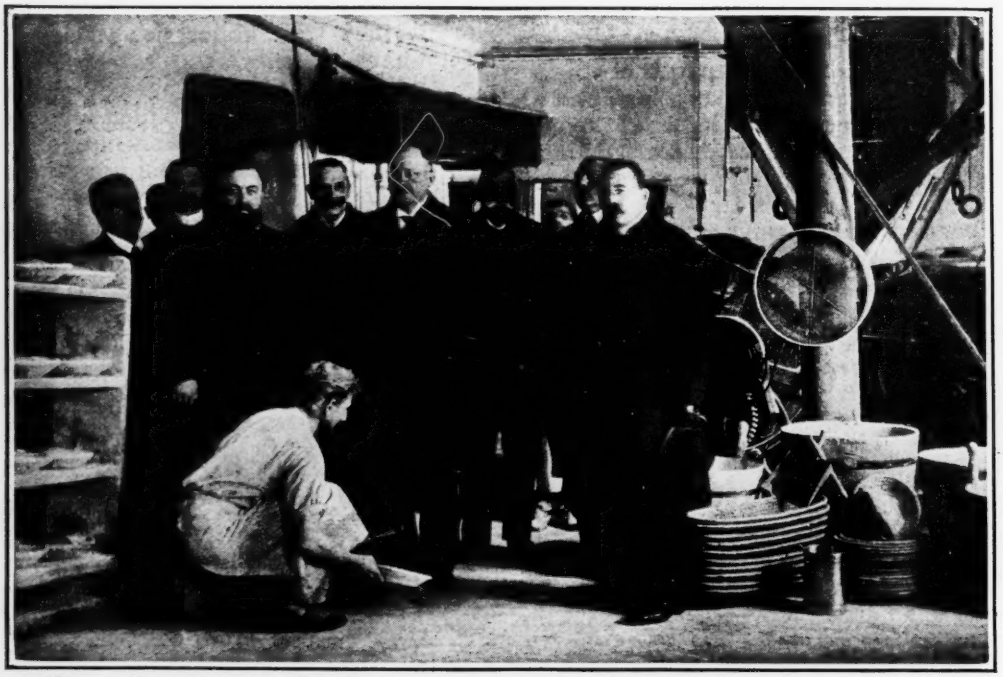
ONE of the most interesting facts brought out in Germany's submarine campaign against British commerce was the accuracy with which the British guns were trained upon occasional indiscreet periscopes.

The periscope tube is small, and an especially difficult target at long range. yet on a few occasions — occasions which were so recurrent that the accuracy could not be attributed to accident —British guns have demolished periscopes, thereby rendering the submersible helpless—an easy prey when she came to the surface.

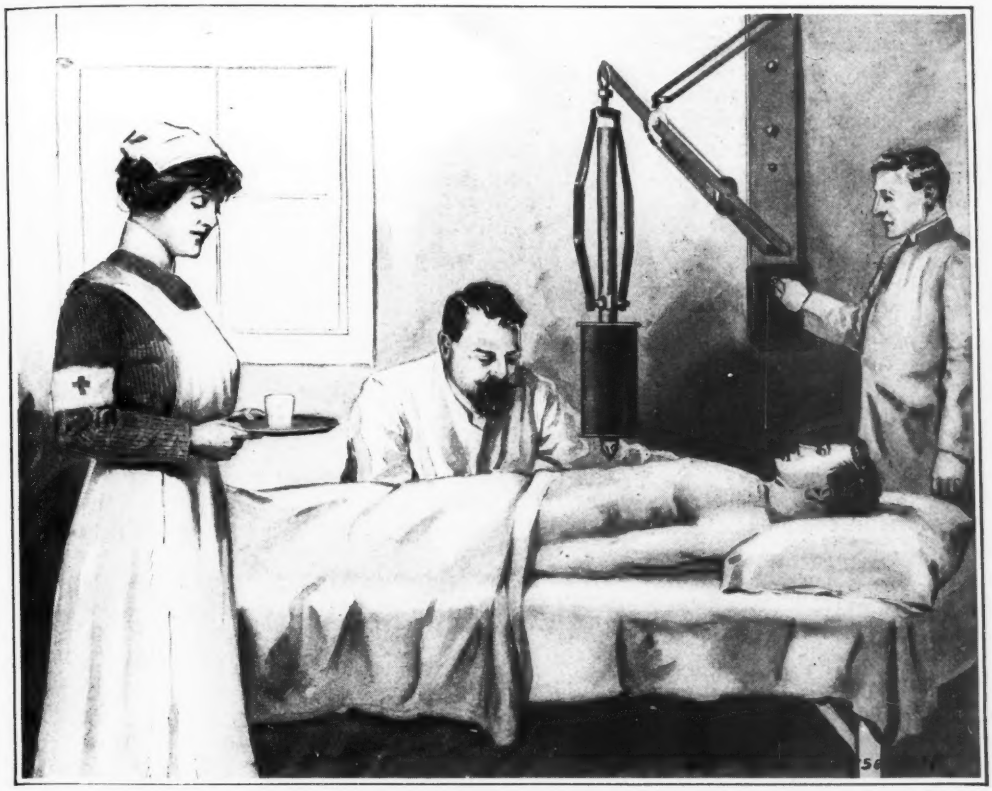
Nor can this remarkable accuracy be attributed entirely to the correctness of the gun design. The fact of the matter is that the British method of range-finding, aside from being one of the most interesting, is one of the most accurate in the world.

Whether the enemy appears in the form of a glinting periscope on the water, a black dot, or a ship on the horizon, the method of range-finding is fundamentally the same. A range-finder works on the same principle as that by which we can estimate a distance with our eyes. Lines drawn from our eyes to the object form sides of an angle. The size of this angle determines the distance. Unconsciously and automatically we reckon distances by the complicated process known as triangulation.

What we estimate roughly with our eyes, range finders determine accurately



The workman is not performing an act of homage. He is simply dusting off the shoes of the Burgomaster of Prague. It is an old Bohemian custom that the boots of all visitors to bakeries must be so wiped



The electromagnet is used with success by war surgeons to extract splinters of steel which are near the surface. When used on deeply buried missiles it has been found to make bad wounds, because the fragment tears its way out through the flesh

with lenses and measuring instruments that are wonderfully accurate.

In the Marindin range finder, which is the type most commonly used in the British infantry, an optical arrangement is used, having an equivalent of two eyes mounted thirty-one and a half inches apart. Two reflecting prisms are employed, so that the rays are brought together in a combined beam to the eye of the range officer.

A more complicated form of range finder is one equipped with magnifying lenses and an adjustable prism by means of which the instrument can be used for recording distances. When the instrument is directed towards some distant object, it will be split into unmatched halves until the prism is adjusted to the correct angle. The distance is then indicated on a dial.

Range finders used on battleships are fundamentally the same as the Maradin finder. They differ only in details.

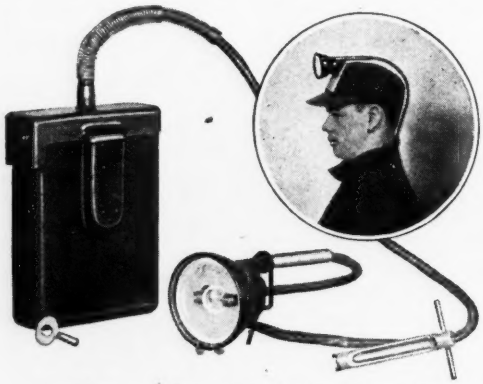
The Electromagnet in War

THE electromagnet has long been used by surgeons to extract splinters from the eye. It has not proved so serviceable when its use has been extended to other parts of the body. In the present war surgeons found that deeplying fragments of shrapnel are literally torn out by the magnet, with the result that gaping wounds are produced which are difficult to handle. For that reason army surgeons, in Germany at least, prefer to restrict the use of the electromagnet to those cases in which the steel splinters lie very near the surface.

A NOVEL device which announces to the chauffeur any overheating of his engine is made so that a streamer is released from the radiator cap to blow against the windshield. The ribbon is made of a bright-colored material, and shows at night as well as in the daytime.

A Miner's Safety Electric Lamp

OWING to the hazardous nature of work in gaseous mines, a demand has been growing for a practical, portable electric lamp. That an electric lamp would be safe to use has been well recognized, because it would be made so that it would not ignite inflammable gases and would produce a uniform light regardless of atmospheric conditions. The perfection of the efficient tungsten lamp in miniature sizes and the development of small, efficient, light weight storage batteries has resulted in the design of the long-desired miner's electric lamp.



A miner's safety electric lamp has long been wanted. This one seems to fill the bill

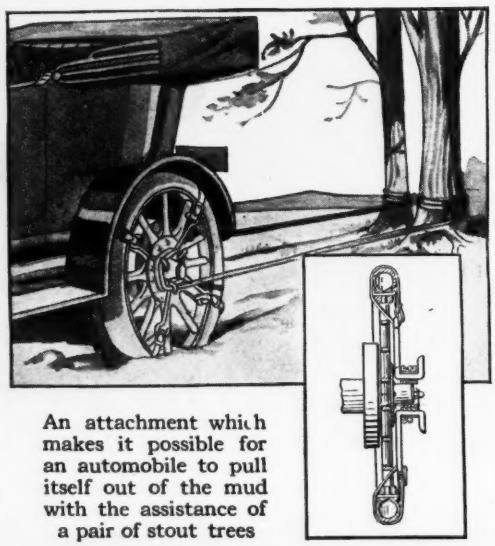
The prime feature of this lamp is that it has been made thoroughly safe to use. By adequate insulation of the entire circuit, placing all terminals and contacts inside of locked and sealed steel cases and providing automatic means for extinguishing instantly the glow of the filament, should breakage of the lamp bulb expose it to the air, this lamp has been made both safe and rugged. The outfit complete weighs but three and three-quarters of a pound, of which three and a half pounds are carried on the belt and four ounces on the cap. The battery will light the lamp twelve hours per charge and can be relied on to furnish light at least ten and three-quarter hours per charge at the end of one year's service.

The bulb is held at the focal point between contact springs, which maintain it constantly under stress, so that, in case of a blow otherwise only sufficient to chip or partly break the bulb, it will be completely shattered by the springs and will drop clear of the contact. Sufficient space is provided between the reflector and glass cover to keep broken lamp parts from short-circuiting the spring contacts. This prevents the possibility of ignition even if the cap lamp is seriously damaged amid explosive gases.

By means of this improved lamp, a miner may work amid a steady white light, and feel secure from devastating explosions.

Using an Automobile as a Winch

AN attachment for the rear wheel of an automobile, by which the automobile may be made to serve as a winch has recently been brought out. Four hooks are attached by straps to the tire. The hooks are bent at their inner ends, and a coiled spring passed through the loops thus formed, so that the hooks point towards the hub. A cable is wound about the loops and securely fastened.



An attachment which makes it possible for an automobile to pull itself out of the mud with the assistance of a pair of stout trees

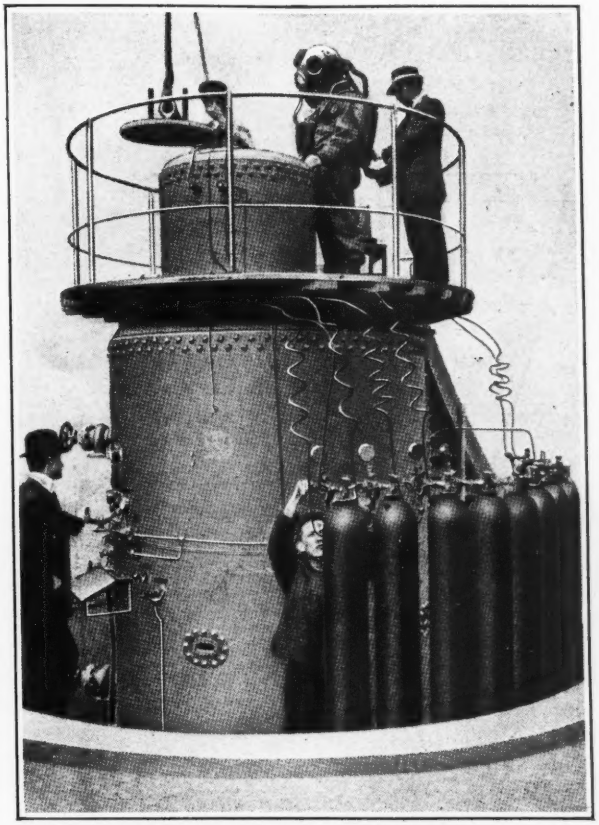
When the motorist finds himself mired, it is a simple matter to pass one end of the rope about the nearest tree or telephone post and then to start the car on the first speed. The revolutions of the wheel wind up the rope, and act as a very powerful winch. The car is soon out.

New Diver's Suit Does Away with the Hand Pump

A GERMAN has invented a breathing apparatus for divers which does away with the cumbersome hand pump and tubes. A diver can descend in the water with no other impediment than a safety rope and telephone wires, and these can be dispensed with if desired.

The feature of most unusual interest in connection with the equipment is the means of refreshing the air. Vitiated air from the lungs is forced into a tank containing several layers of potash through which it percolates. The potash cartridge absorbs the carbon dioxide. The oxygen supply is replenished from a small oxygen tube as it is required.

Caustic potash has been found to be the most satisfactory chemical for absorption purposes. In this new device it is placed in a number of shallow trays one upon the other; so that the air passes through each layer.



The air inhaled by the diver is purified chemically and breathed again and again through an apparatus which he can carry on his back. The diver is about to enter a tank in order to test the apparatus

An Ancient Wooden Leg

SOME years ago, when archeological researches were going on at Capua, Italy, the excavators came upon an ancient tomb. Upon opening it they found it to contain a rather unusual relic of the past. A skeleton was found, and with it were numerous objects supposed to have been associated with the living personage of whom this was the sepulchre. One of the objects, as to the use of which there was no doubt, was an artificial leg. One of the leg bones of the skeleton was missing, indicating that the leg had been interred with the wearer. The artificial limb, a creditable mechanical contrivance, was made of a combination of bronze, wood and iron.

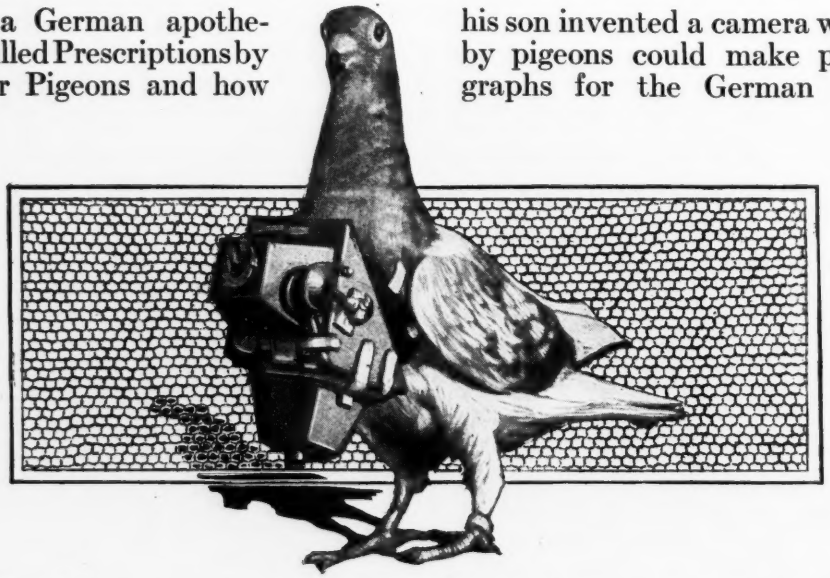
Fortunately, the tomb also contained some evidence as to the age of its contents and the period in which the wearer of the wooden leg might be supposed to have been walking on it. Three vases were found which were decided upon as being representative of the period which had ended some three centuries before the birth of Christ.

With this remote date practically fixed as a time when very advanced forms of artificial limbs were in use, an interesting light is shed on the antiquity of their invention. It is natural that there should be a considerable period of development between the first crude effort and a fairly well-finished combination of wood and two different metals.

The artificial leg here mentioned may still be seen, preserved in the museum of the Royal College of Surgeons in London. It is an evidence that archeology may teach even the surgeon.

The Pigeon Spy and His Work in War

How a German apothecary filled Prescriptions by carrier Pigeons and how his son invented a camera whereby pigeons could make photographs for the German army



ONE of the strangest phenomena of the war has been the revival during its course of methods and implements used in the warfares of medieval times and even of antiquity. We hear of slings and catapults for firing explosive bombs a short distance, of arrows shot from aeroplanes, of helmets, breastplates, and shields for the protection of the soldiers. Now, last of all, comes word that pigeons, the carriers of intelligence in times of stress in remote times, are used as photographers of the positions of the enemy. It is a strange medley, the air-ship, the last and most daring invention of man's brain, rising in the early dawn to search out and photograph the foe's movements, and the graceful pigeon, so frequently mentioned in the stories of early days, soaring, perhaps at the same moment, to act as an aerial scout.

But modern ingenuity has added something to the older roles of the carrier pigeon—and has turned him into a photographer. The only authenticated reports of this use have been found in accounts of a German invention, some of the pigeons having been brought down behind the allied lines. Whether the Allies have tried the same means of getting photographs of German entrenchments and troops is a matter of conjecture.

The story of this development of the pigeon's work goes back to 1840, and the enterprise of a German apothecary of Cronberg named Neubronner.

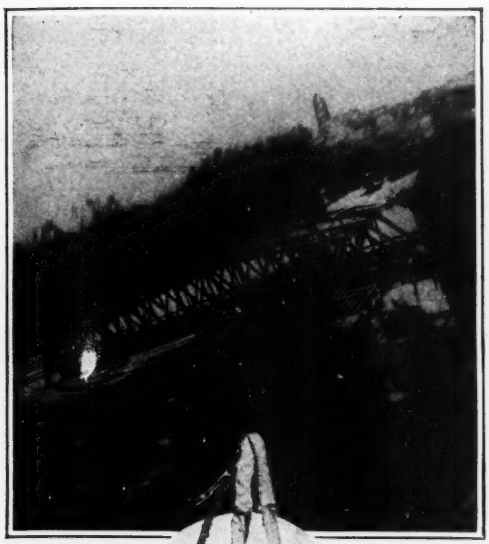
He gave the doctors of the surrounding country pigeons by which they could send him prescriptions needed in haste. In this way the medicine was ready by the time the messenger with the other copy of the prescription arrived. In urgent cases the apothecary, himself, sent a messenger with the preparation. This ingenious sales' service was carried on for a long while.

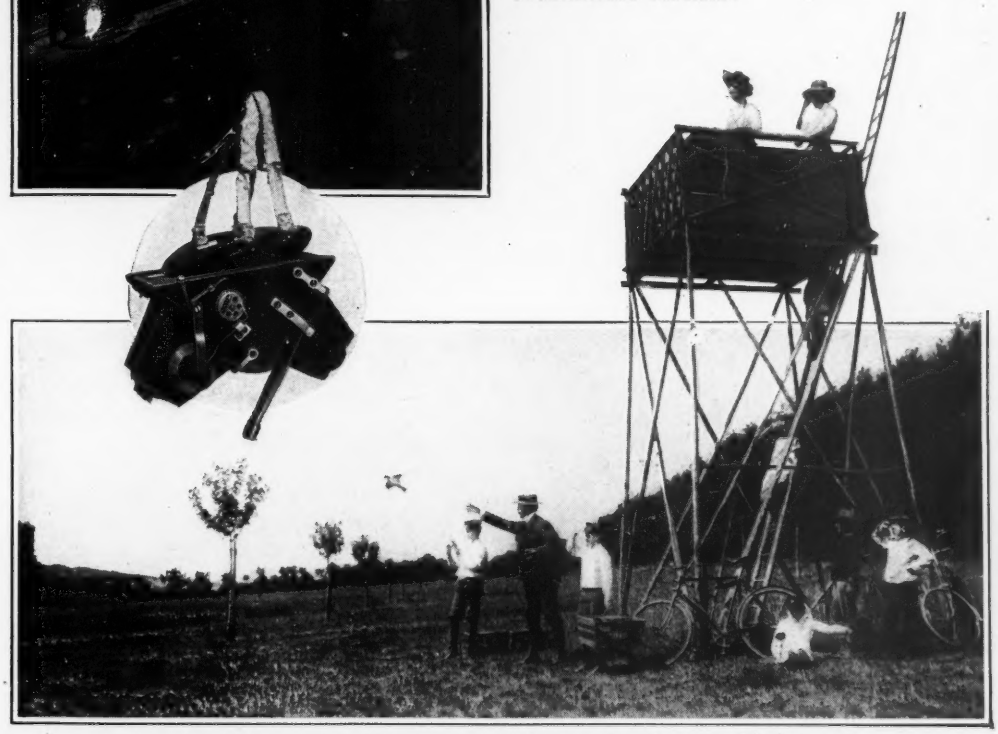
The apothecary's son, Dr. Jules Neubronner, like his father, also had pigeons which he used to convey orders between his house and the sanatorium of Falkenstein, or to carry small doses of medicine, for which he had telephoned to his apothecary. One of his pigeons, a few years ago, stayed away for a month, and this led the doctor to devise a plan by which he could tell where his pigeons went when they were let loose. To this end he used a small, light photographic apparatus which could take views during a flight of about sixty-five feet a minute. The apparatus is arranged to fit the breast of a pigeon to which it is held

by elastic bands that pass over the back. The shutter opens automatically at prearranged intervals and the roll of film, which moves in unison with the shutter, can take thirty photographs one and a half inches square. This allows an almost continuous registry of the principal points of view during a flight of six miles. One of the engravings shows a view taken in flight by the pigeon photographer. The general staff of the German army heard of Dr. Neubronner's ingenious device and investigated its adaptability for topographic reconnaissance. The method was evidently found satisfactory, for since the present war broke out many pigeon photographers have been found back of the Allied lines either killed or stunned by the explosion of shells and firing of machine guns.

The history of carrier pigeons in war goes back to the earliest times. Pliny tells us that Decimus Brutus, one of the assassins of Caesar, used pigeons, when besieged by Antony at what is now Modena, to communicate with the Consul Hirtius who was coming to his aid. The crusaders are known to have used them at the siege of Hasar near Aleppo, and the medieval Sultan Noureddin of Egypt is said to have established a pigeon-post with relays of pigeons. Among the noted instances of their use in modern times is the story that the London Rothschild knew of the defeat of Napoleon at Waterloo, by means of carrier-pigeons, ahead of the English government, to his great financial benefit on the Exchange. But then, this is only one of a dozen stories of the origin of the Rothschild fortune.

Photograph made automatically by a carrier pigeon in its flight





Releasing a carrier pigeon from its basket on its photographic journey

No Chance to Pass This Shop

THERE is more than one way of impressing upon the public that at a given point refreshments are for sale The accompanying illustration shows how one merchant frightened passing motorists into noticing that he had refreshments for sale by an adaptation of a railway block signal. His store is on the state highway of California in the cactus country between Burbank and San Fernando. Few drivers pass this point without glancing up at the "warning" sign, incidentally reading the words on the down board, "Hot and soft drinks."

"Frightening" the motorist into drinking lemonade

This sign is made doubly effective by the fact that a few yards from it runs the main line of a prominent railroad. The driver proceeding along this stretch of road is naturally on the lookout for warnings.

An Illinois Community with Ideas in Street Lighting

Nature built these lamp posts

IN the village of Kenilworth, Ill., the people carry out commendable ideas in ornamenting public grounds. They employ attractive methods in hanging their street lights. One of the plans is to suspend a square frame around a shade tree. An electric bulb, strong and brilliant, hangs at each corner of the frame.

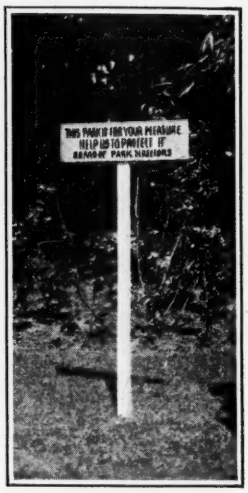
All signs and sign posts which the community finds necessary to place in the streets for the information of drivers and pedestrians are tastefully constructed.

In this village the plan of planting lawn trees in pairs and trios has been adopted. This is done to secure an immediate effect. Slender Carolina poplars are thus made to show considerable foliage in a very short time.

There is one big market and grocery store in this charming little Illinois town. The entrances to this building are banked with flowers.

Polite Sign Boards Bring Results.

A POLITE request is often more effective than a peremptory order. Hence the board of park directors tried the scheme in a small park near Lake Merritt, Calif.


Signboard that appeals to public sense of honor and civic duty

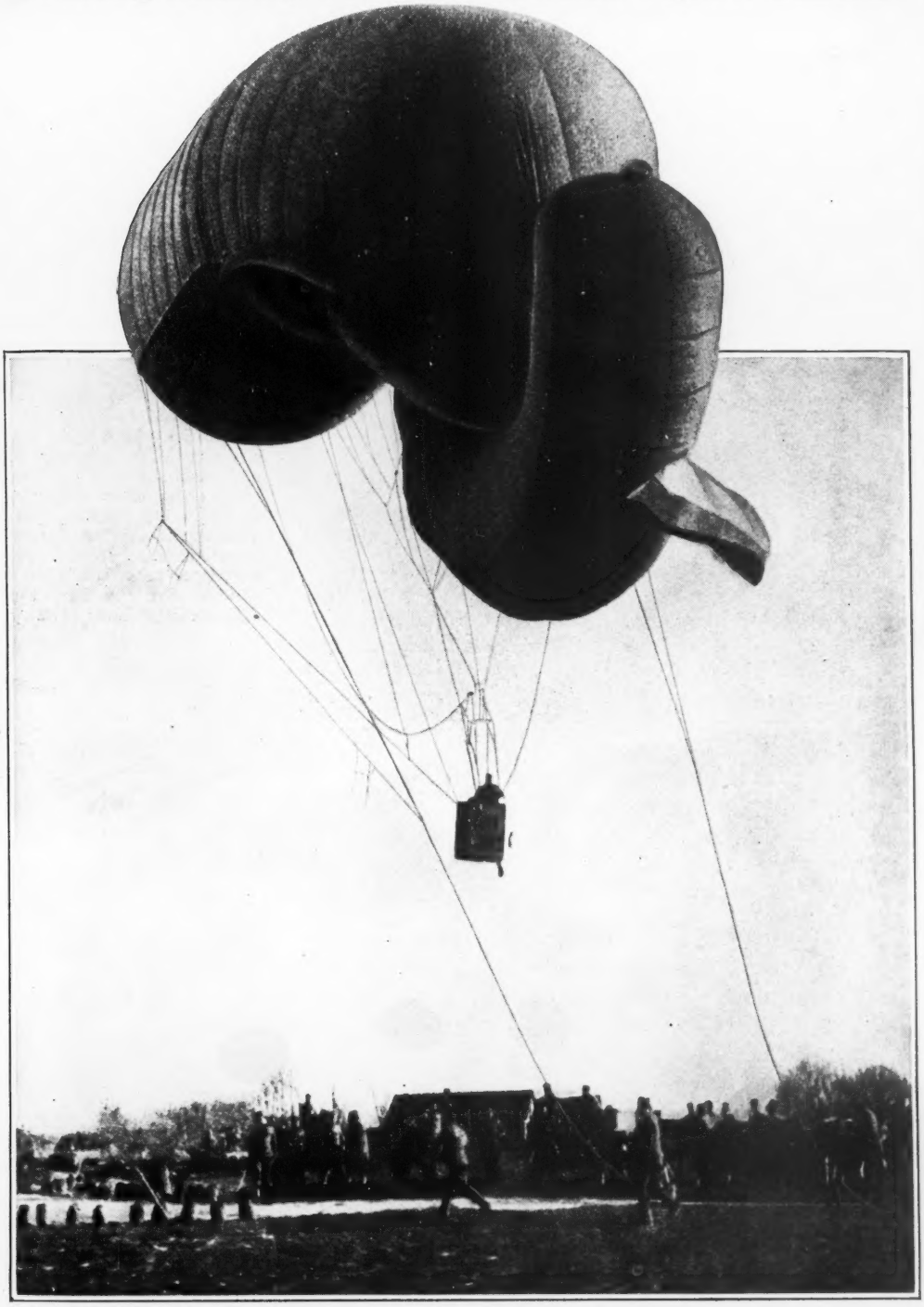
Instead of the usual order, "Keep off the grass!" or "Do not throw rubbish here!" a polite request reading, "This park is for your pleasure. Help us protect it!" has been put up on a small sign board. The directors of the park claim that it is much more effective than the old signs.

The same method is followed by the street cleaning department of New York city, where the ash carts carry continually changed signs urging the public to "Keep YOUR city clean."

Artificial Sausage Skins

A GERMAN butcher has recently patented in this country a process for making artificial sausage skins from fibers of animal sinews. According to the inventor these fibers, which may be purchased very cheaply from abattoirs, may be cleaned more thoroughly than the intestinal skin. The sinews are digestible, and it will do no harm if pieces of the skin are swallowed.

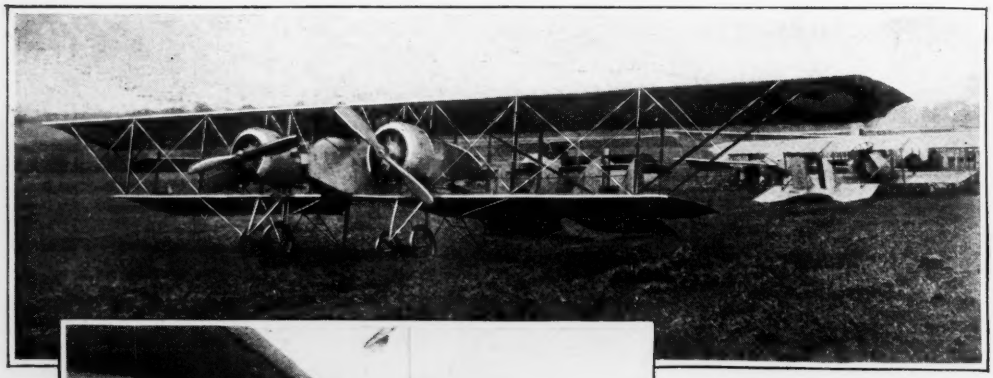
Directing Artillery Fire from a Serbian Captive Balloon



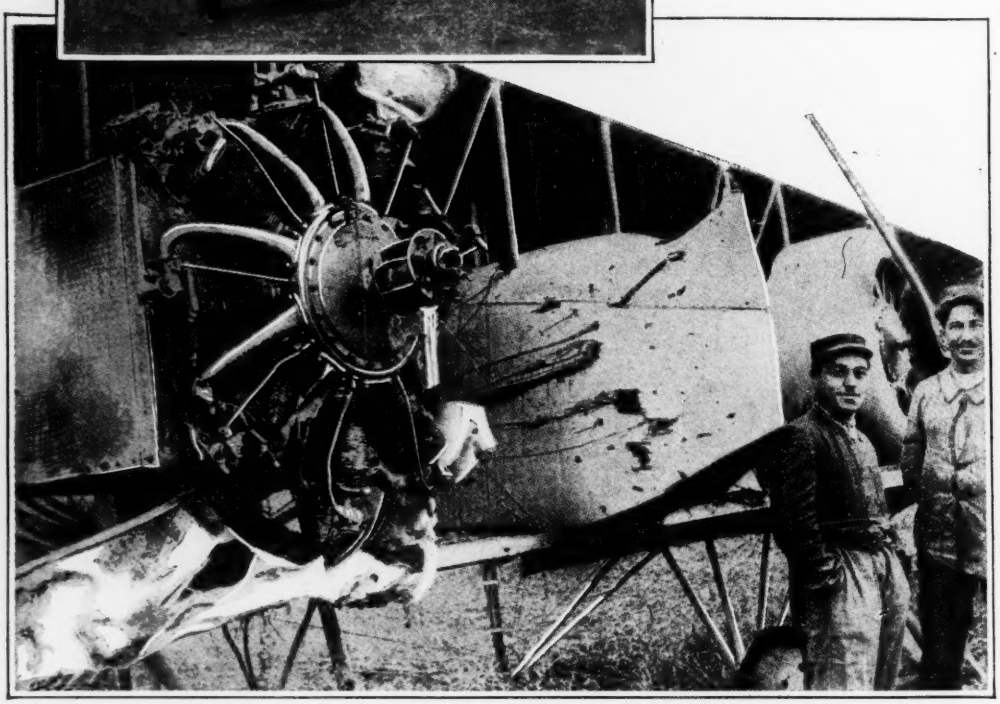
© International Film Service.

A Serbian captive observation balloon ascending for a survey of the Austro-German positions. This is built on the German Parseval plan, the sausage-like appendix to the main envelope acting somewhat like the tail to a kite, giving the balloon great stability in the air. Such balloons are almost standard in European armies

The Wings of Death



An armored French Caudron battle-plane (above), equipped with two engines, and a central fuselege which carries the pilot, observer, and a heavy machine gun. These machines are recent developments, but are giving very good account of themselves. On the left, the arrival of a biplane at Nancy



The result of a well-placed German shell, putting out of commission one of the Le Rhône rotary motors with which this machine is equipped. This is the same type of aeroplane as that shown in the illustration at the top of the page. Note the effects of the shrapnel upon the engine and the fuselege of the aeroplane

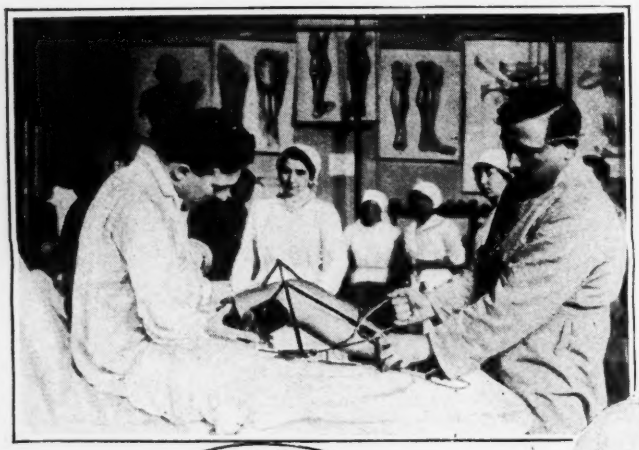
Work and Play After the Battle is Over

© Brown & Dawson

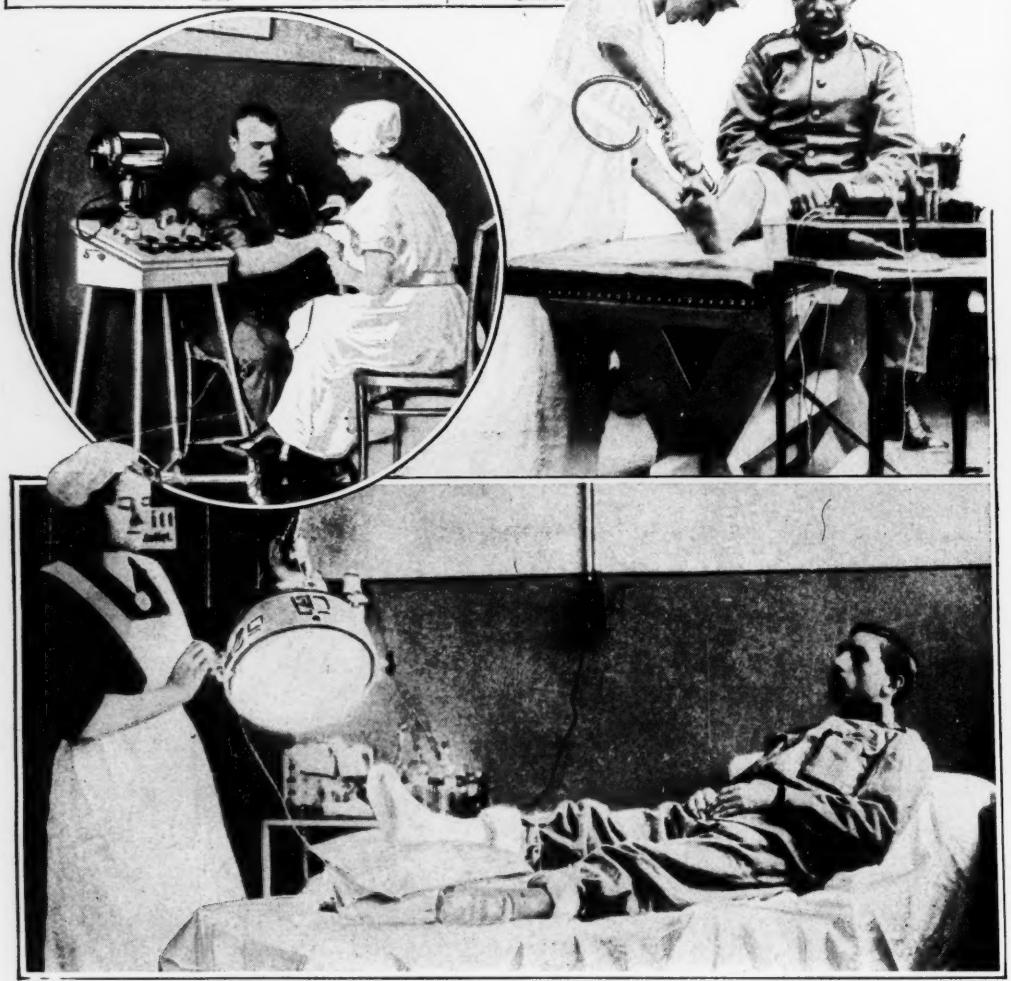
© American Press Association

Wounded Tommies recover strength and health in the convalescent camps in which they are prepared for future work in the trenches. Above are shown Russian prisoners making uniforms for German soldiers—a less athletic employment

Electricity in the Hospitals



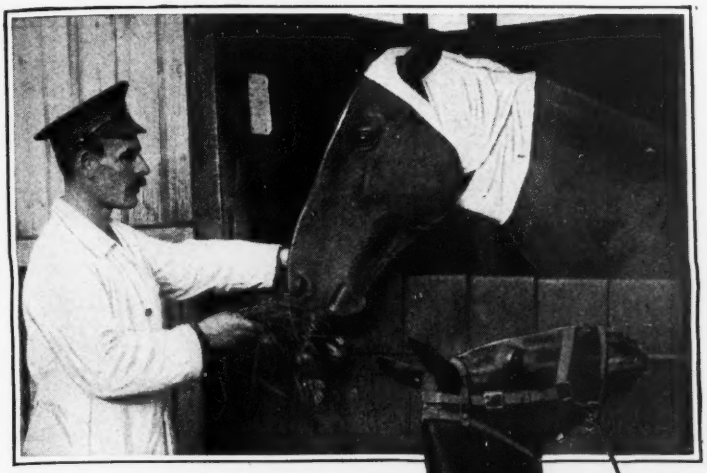
On the left, a mechanical appliance for straightening a wounded leg. In the process of healing, the leg became bent and the muscles taut, and unless straightened would be useless for life. Below, an electric massage use to restore circulation in an injured limb



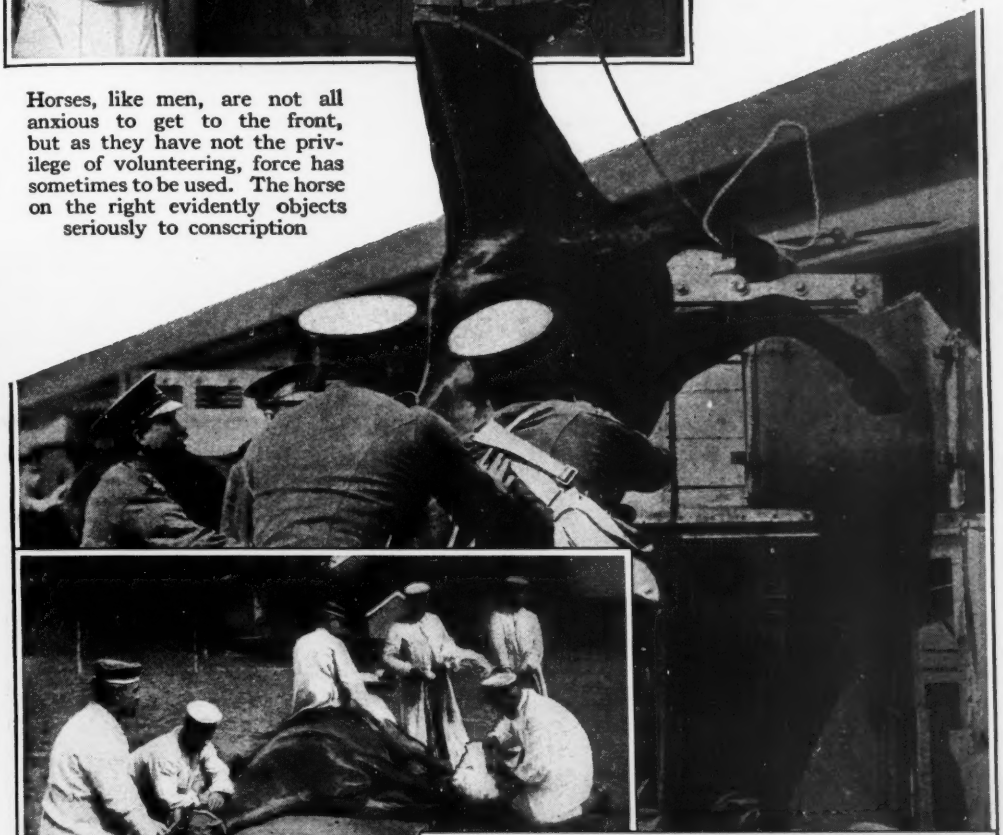
© Photos by Universal Press Syndicate

In circle, treating the wounded by electricity in an Austrian base hospital. Every method known to surgery is employed in the base hospitals of the contending armies to heal the wounded for further service in the field. Below, an artificial sunbath. These ultra-violet rays act exactly like the rays of the sun, cleansing the blood and killing germs

In the War Hospitals for Horses



A hospital has been established in Kent for victims of the war whose names do not appear on any casualty list. The inmates are horses which have been wounded or have contracted illness, and are being cared for by the Army Veterinary Corps, whose work is almost as important as that of hospitals for soldiers



Horses, like men, are not all anxious to get to the front, but as they have not the privilege of volunteering, force has sometimes to be used. The horse on the right evidently objects seriously to conscription

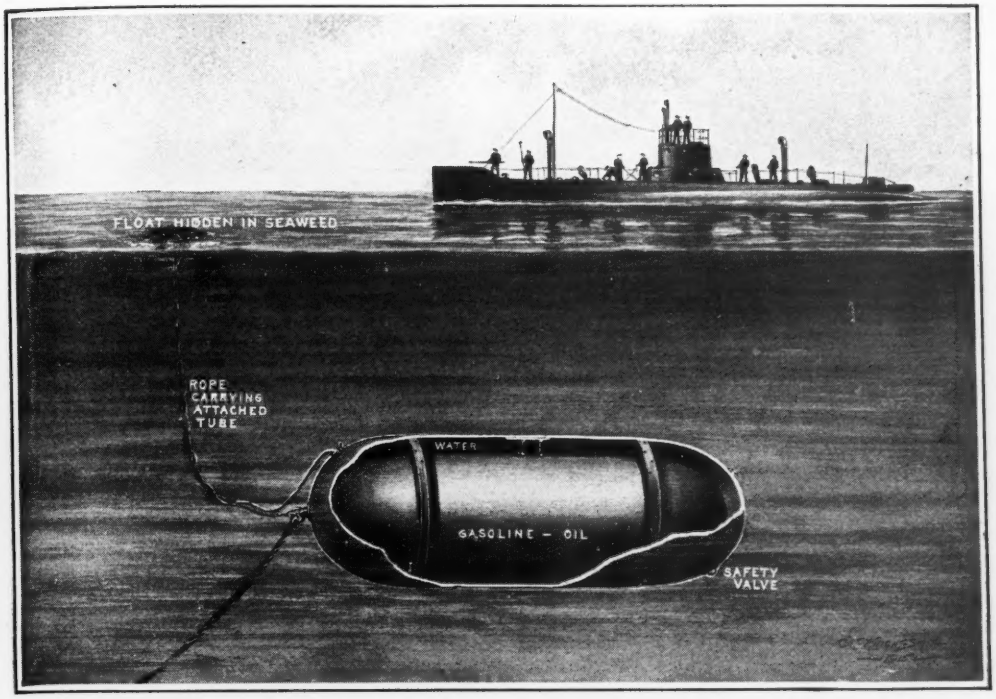
In German hospitals for horses the best of care is taken of the dumb animals, and special organizations have been formed for the sole purpose of treating injured horses. The horse on the left has just undergone an operation upon an injured hoof

Done For

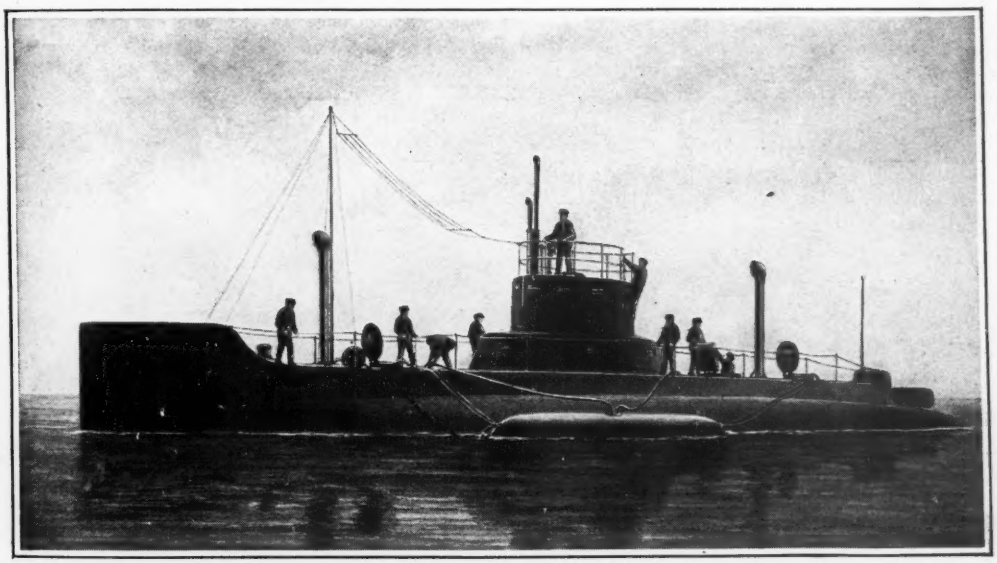
© Underwood & Underwood

The result of a premature charge. It is an accepted rule among the warring nations that the enemy's barbed wire entanglements shall be blown to pieces by artillery fire before the command is given to charge. These Russians have met death in the midst of the barricades defending the German positions in Poland

Secret Gasoline Supplies for Submarines



A submarine at sea can replenish its supply of gasoline or oil by means of the device illustrated. Within an outer container, a tank of gasoline or oil is placed. Between the outer container and the gasoline tank is a space filled with water. When the water is forced out by compressed air, container and tank rise to the surface



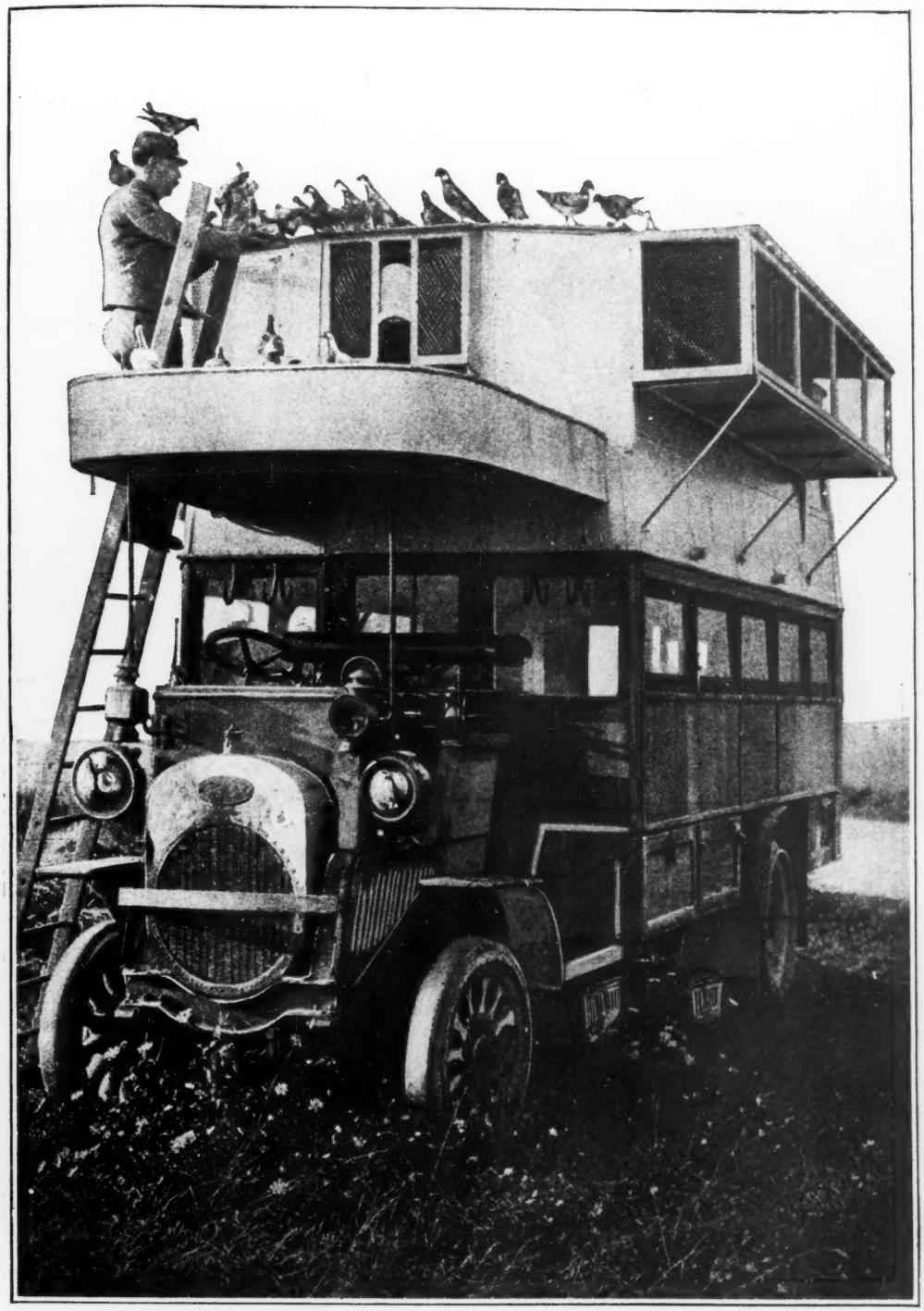
A float hidden in seaweed conceals the means of raising the tank to the surface. After the tank has been brought to the surface the submarine proceeds to replenish its supply of fuel by the simple expedient of pumping it into its reservoirs

Jack Frost, at Least, Will Be Routed

© Photos by Underwood & Underwood

In the upper pictures are shown some of the new sheepskin sleeping bags which will be served out to the allied troops. In the bottom picture, a German master tailor is applying efficiency methods to speed up the output of winter uniforms. A number of layers of cloth are put upon the cutting board, and a sharp disk swiftly follows the pattern, cutting the entire pile at the same time

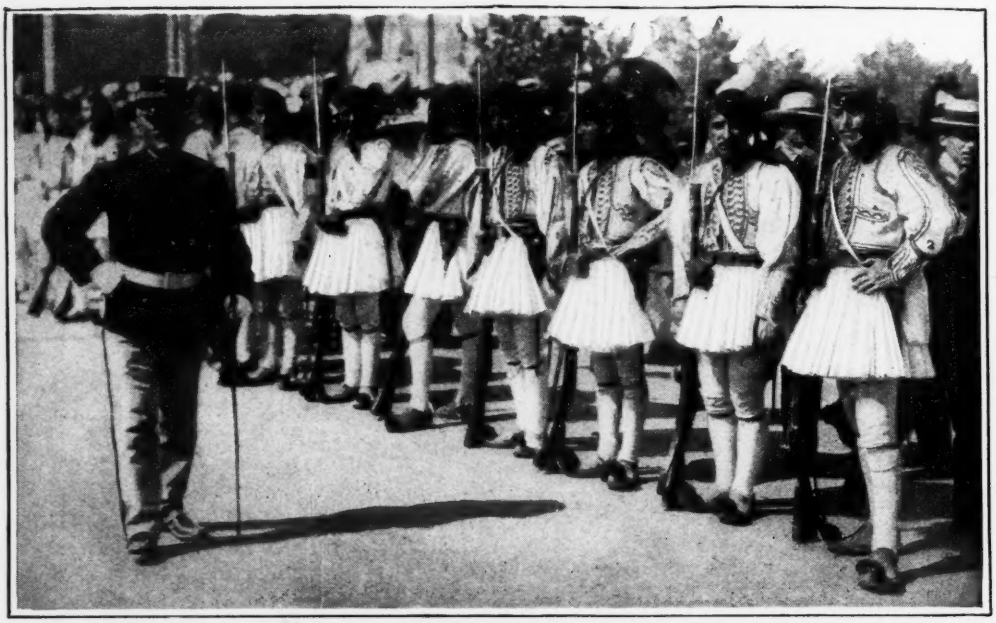
The Doves of War



By Courtesy of Illustrated London News

A motorbus converted into a dovecote for the housing of pigeons until they are needed for service which no man or telegraph wire or wireless can perform

Odd Glimpses of the War



No, these are not chorus men. Despite their ballet skirts, tights, and fancy shoes, these Greek Highlanders are real fighters. They are seasoned campaigners, and may have an opportunity to test their prowess—but clad in more war-like garb

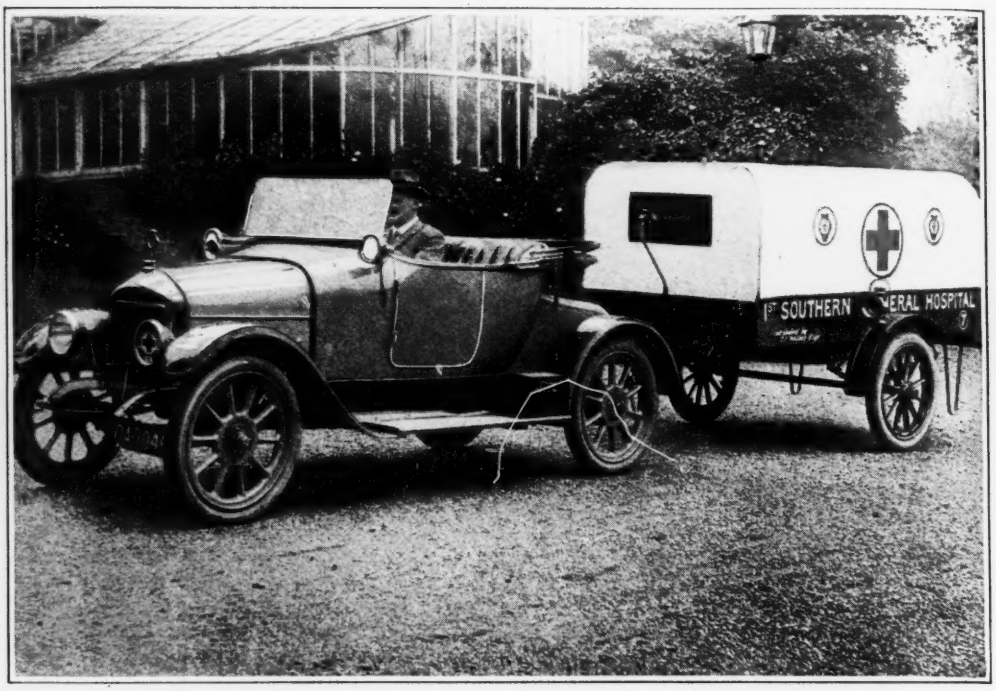
© International Film Service

Members of the American Red Cross in Belgrade spraying Serbian soldiers with disinfectant upon their return from a long stay at the front. Serbia is still vermin-infested and disease-ridden, although typhus has been stamped out

© American Press Association

One of the twelve-inch guns on the British battleship "Canopus." Although these guns are extremely powerful, and throw a great mass of metal, a newer ship, such as the "Queen Elizabeth," could stay well out of range of the "Canopus," while with her bigger guns she could hammer her opponent to pieces without the slightest risk to herself

Extremes of the War Transportation Problem



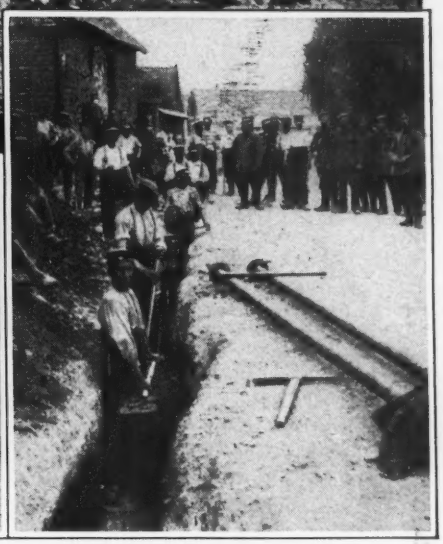
Private motorists in Great Britain are giving much of their time to volunteer ambulance work. They have supplied many of their pleasure cars with ambulance trailers as shown in the illustration and are doing useful work in carrying the wounded

Military trucks are sometimes mired in the swamps and mud holes near the front, especially on the Russian battlegrounds. Here is a German ammunition truck being pulled through a Polish swamp by a large force of soldiers

Unmilitary Phases of War

Austrian soldiers aiding Russian peasants behind the lines in gathering their harvest. By means of these harvests, the Austro-German forces are able to keep well supplied with food material. The two million Russian prisoners are probably being used to maintain the economic strength of both Germany and Austria. The French and English prisoners are not used for this work so much as their allies from the East

German soldiers pulling down a tall chimney which had been partially shot away during the bombardment of a town in Russian Poland. The ruins of war are now treated as any other ruins are handled in peaceful communities everywhere



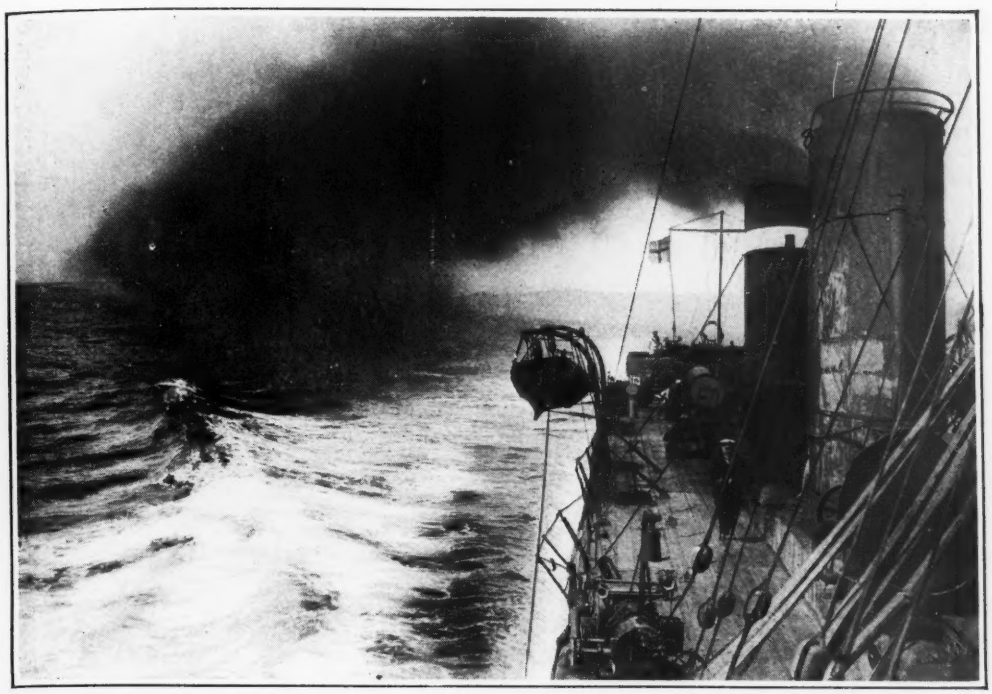
©Photos by Universal Press Syndicate

Elephants from Hagenback's Zoo at Hamburg (on left) hard at work removing logs and timbers for the German soldiers. The trenches were only a short distance from the French town shown in the illustration, on the right, so the Germans laid underground pipes from the water supply system of the town, and thus piped fresh water into their trenches

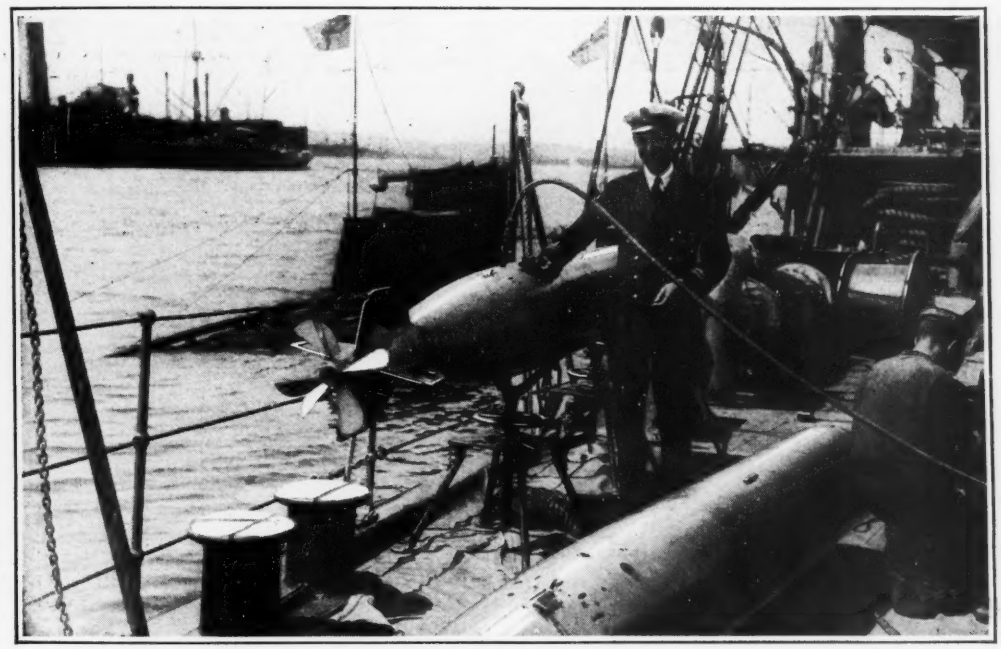
Salving Seven Thousand Dollars' Worth of Death

British Jackies hoisting a spent torpedo to the deck of a torpedo-boat destroyer. Torpedoes such as the one shown cost nearly seven thousand dollars, and, as may be imagined, is considered worth saving

Behind the Screens of Smoke and Sea



The British destroyer "Kennet" making a smoke screen to protect the Allied fleet from the fire of the Turkish batteries in the Dardanelles. Oil is poured on the fires and dense clouds pour forth to hide ships from the enemy. The ruse is used by all navies



Torpedoes for the submarine in the background are being filled with compressed air at a pressure of one ton to the square inch. This compressed air runs the motor which sends the projectile at express speed, as well as the gyroscope spinning devices

Not a Cliff Dwelling, But a Modern Trench

Courtesy of Illustrated London News

A three-storied French field fortification, an example of France's remarkable skill in defense-works and dug-out shelters. The walls of this huge first line trench are constructed of solid stone, and numerous sand bags and cylindrical baskets filled with earth serve to deaden the explosion of any shell which reaches the trench

What War Means to Women

Women postmen have entered the German postal service

A woman cobbler mends shoes for many residents of Berlin, while her husband is at the front

Two Berlin window cleaners starting out for their day's work

With true Teuton thoroughness, the German government has opened the ranks of labor to women so that every available fighting man may go to the war and defend his country

earth serve to deaden the explosion of any shell which reaches the trench

Mimicking the Ermine in War

As winter comes on the ermine changes his coat of brown to one of white to match the snow and escape his enemies. Soldiers of Austria's mountain battalions have torn a leaf from nature's book. They, too, garb themselves in white to escape their enemies

Since they must travel on snow-covered mountains the Alpinists of the Austrian army use Norwegian skiis. Austrian snow patrols often raid the opposing scouts by sliding down the mountains at a terrific rate on their skiis, shooting as they go. The momentum of such a charge is almost irresistible, and they are often able to rout a superior force by sheer weight and daring

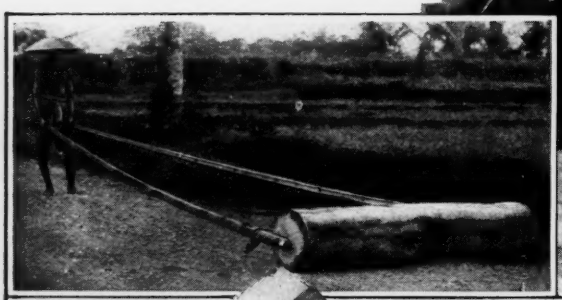
An Indian Wedding Party

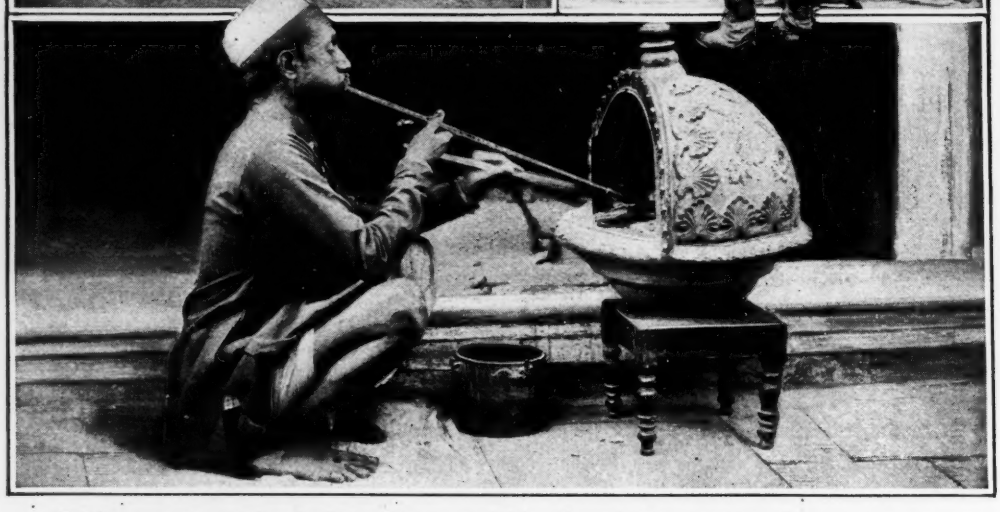
© Underwood and Underwood

A strange Indian wedding party. His Highness, the Chief of Akalkota, and guests being drawn in an omnibus-like vehicle by two huge elephants, and guarded by the Chief's Guard of Honor. Oriental splendor makes the most of all its opportunities, and a royal wedding party is second only to a coronation in the chance for display

Curious Trades of Other Lands

The world's largest open-air pottery market, in Korea (above). At the right, an itinerant Korean brandy dealer, with his ample stock in trade





Taking sago to market in Java (above on left). Sago is the marrow of a palm, and to transport the palm trunks to market, the Javanese nail them to long poles and roll them over the roads. The silversmith shown in the lowermost picture is able, with his rough tools, to do work that is the marvel of the world. Even his clay stove is a work of art

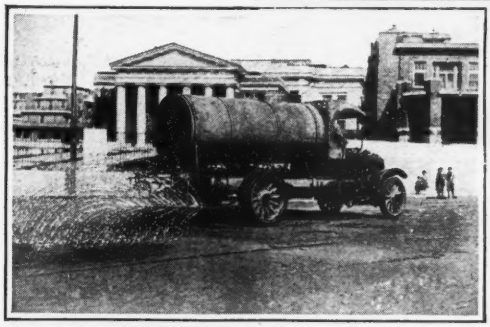
A Jack-of-all-Trades Truck

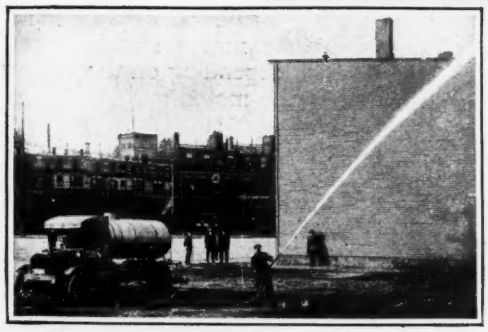
THE city of Boston has recently put into service a versatile motor truck that serves in many capacities. When equipped with a dumping body it is a most efficient ash collector, but when equipped with its nine hundred gallon tank body, however, the truck makes its best showing. In this form it may be used either as a street sprinkler, to supplant three water carts, or as a street oiler, in which capacity it covers twelve thousand five hundred square yards in the short time of eighteen minutes.

The forty regular sprinkling nozzles are assisted in their work by a rotary pump which raises the pressure to forty pounds, and this pump is also capable of removing the contents of the tank through a side opening, thus saving labor of discharging it at the top.

In cases of isolated fires, as among lumber piles, the truck with its powerful pump becomes an efficient fire fighting appliance. It throws a stream of water of equal power to the ordinary fire engine and can get to the scene of the conflagration quickly.

Authorities in the city state that the truck easily accomplishes the work of six horses and two drivers.





The City of Boston's handy motor truck, which carries dirt, sprinkles roads with water or with oil, and puts out fires with equal versatility and effectiveness

Why a Woman Can Outtalk a Man

A WOMAN can talk longer than a man, and does so because she uses less force by a larger percentage than a man does. A German professor has proved by actual and very delicate measurements that the baritone singer uses far more energy than either. The range of voice differs greatly, so the

percentage varies to the same extent, but as a general result it was proved that a tenor uses only from one-seventh to one-sixteenth of the lung power of the baritone or bass. The difference in the force used by the contralto and soprano is very marked, and the contralto who sings in very deep tones uses at least ten times the force of the soprano.

The explanation is so simple that it is surprising that it was not thought of long ago. It has long been known that the tenor or soprano brings the vocal chords together and keeps the edges vibrating only by the emission of air. The bass or contralto leaves the space between the chords wider open, and has to vibrate much more of the membranes.

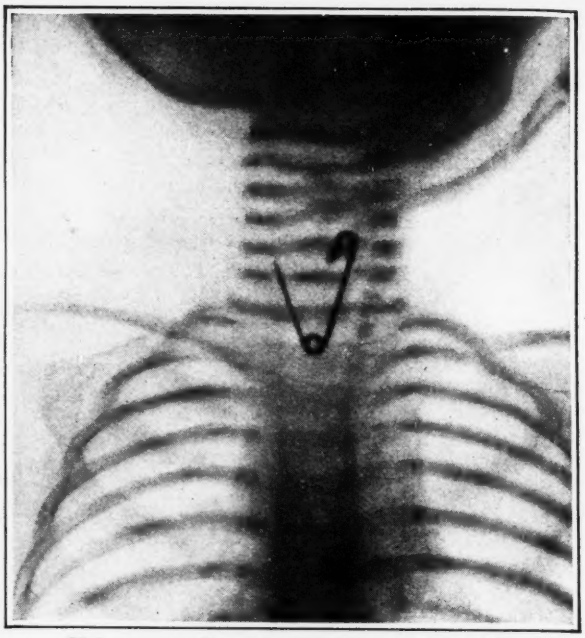
A Need for Electric Rickshaws

ACCORDING to advices from India, there is no reason why small electric vehicles should not replace the rickshaw in hill stations, where these are now in general use. The overall dimensions of the vehicle need not be over eleven feet by five feet.

X-Ray Finds Safety Pin in Baby's Throat

REMOVING an open safety pin which was swallowed by a seven-months-old baby with the sole aid of X-rays and a snare, was the remarkable operation recently performed by Dr. G. S. Otrich, of Belleville, Ill.

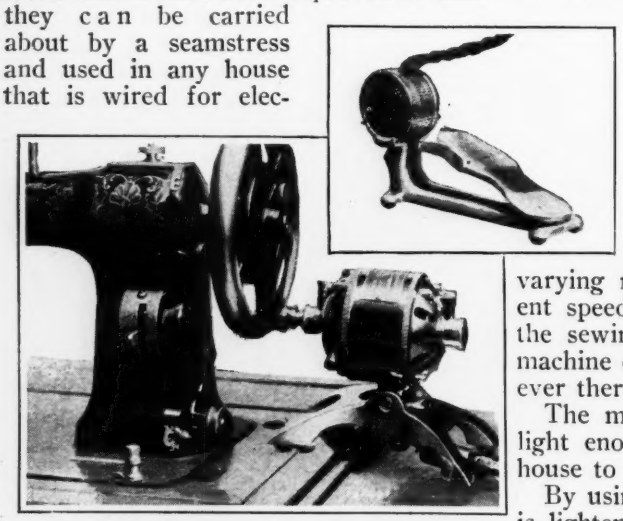
When an X-ray photograph was taken of the child, it was discovered that the open pin was lodged in the esophagus, with the point sticking upward towards the child's mouth. The X-ray tube was arranged beneath an ordinary table, so as to throw the light upward, and the child placed so that the light from the tube would be in a direct line. A fluoroscope was adjusted directly over the child, and the obstruction became clearly visible. The doctor passed a small snare into the esophagus, and with infinite care passed it slightly beyond the pin. After withdrawing it until the pin seemed to be engaged, he closed the snare. On the first attempt the pin was closed and withdrawn.



This open safety pin was extracted with a snare by the aid of the X-ray and a fluoroscope

A Foot-controlled Sewing Machine

MOTORS for driving sewing machines have been improved so that they can be carried about by a seamstress and used in any house that is wired for electricity and attached to any machine in half a minute. The motor is equipped with feet so that it can be set on the stand and applied to the flywheel of the sewing machine without the use of any screws or arms. In addition it is governed by a pedal which controls the speed, from a stitch a minute to eight hundred stitches a minute.



The foot still controls this sewing machine, but a motor does the real work

The motor stand is simple, depending on the weight of the motor and its rubber feet for stability. The little ledge of the sewing machine itself forms a brace so that permanent attachments are not needed.

The pedal sends the current through a rheostat of varying resistance to obtain the different speeds required by the operator of the sewing machine. Thus the sewing machine can be electrically driven wherever there is a light socket.

The motor and its attachments are light enough to be easily carried from house to house.

By using it the work of a dressmaker is lightened by at least a half, and the physical tire of working is almost completely eliminated.

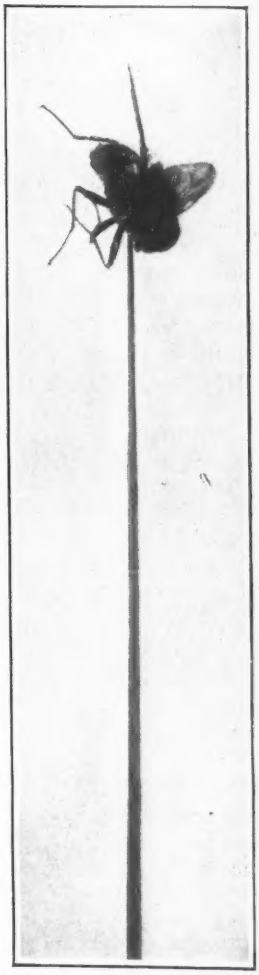
Roots instead of branches were grafted to this pear tree, and with the fresh life brought to it by the healthy young suckers, the old tree returned to its previous record crops

Giving a Pear Tree New Roots

THE startling operations performed upon human bodies by advanced surgical methods find their counterpart in tree surgery. How a pear tree was supplied with new roots after its own had been destroyed, is an example. The disease which required the drastic treatment of removing the roots of a well-grown tree is "pear blight," which can be eradicated only by cutting away all affected parts. So dangerous is this tree disease that even the knife which is used in cutting away the bark, wood or roots must be sterilized after each use, in order to prevent the contagion from spreading to sound parts of the tree.

Should the disease attack the roots, as in the instance shown in the photograph, it is necessary to supply nourishment to the tree by grafting to the trunk a number of healthy young "suckers." These are well rooted and are set into the ground about the diseased tree, while the upper ends are grafted upon the trunk, so as to carry the sap from the ground by healthy channels.

Fly Impaled by Spear of Grass



ONE of the most interesting accidents that has ever come to the attention of zoologists is shown in the accompanying illustration. While lying in the tall grass near Fire Island, N. Y., waiting for game birds, Dr. A. L. Goodman, a New York physician, saw a fly perching upon a spear of grass near him, and entirely unafraid of the hunter, for it never moved. After watching the fly for nearly half an hour, Dr. Goodman's curiosity was so aroused that he got up and, upon examining the insect, found that the sharp point of the grass had pierced the fly's frail body.

The insect had evidently been flying against the wind, when a sudden gust blew it down against the blade of grass, which had swayed with the wind. Dr. Lutz, of the American Museum of Natural History, says that in the fifteen years that he has collected specimens he has never seen a similar accident, nor has he ever read of such an occurrence.

Hammering Spine to Cure Sick Heart

AS a remedy for enlargement of the heart, Dr. Meyer Solis-Cohen hammers the spine with a rubber-tipped hammer. The tapping should be done on the protruding vertebra in the spine at the bottom of the neck, a little above the shoulderblade. It immediately livens the valves of the heart.

A Three Million Dollar Automobile Scenic Highway

By Fred W. Vincent

HIGH masonry walled roadways clinging to precipitous mountain sides and so cunningly built that no cement enters into their composition; bridges of solid concrete spanning deep mountain gorges, and tunnels through living rock are only a few of the features of the Columbia Highway, a two hundred mile three million dollar roadway that Oregon is rapidly driving through the heart of the Cascades and Coast Range mountains, down the Columbia River, from The Dalles to the Pacific Ocean.

For two years the work has been underway, guided by engineering experts who first spent months in Europe studying the famous mountain roadways there with the sole object of not duplicating, but of bettering the best the Old World had to offer.

From the Dalles, where it connects with the trunk roads leading into the interior and the East, the highway follows the south bank of the Columbia—second largest river in the United States—and plunges into the rugged and picturesque Cascade Mountains. Here on one side for more than fifty miles is the river, on the other a rock wall rising sheer for heights varying from a few hundred to thousands of feet. It is through this majestic water carved gorge that the engineers faced and solved their hardest problem.

Their instructions were to build a roadway not less than twenty-four feet in width and with a grade not to exceed five percent at any point. A railroad had possession of what little shoring there was along the river, and for this reason the construction force faced miles on miles of cliffs, long reaches of slope deep with slide rock, and a timbered wilderness with earth pitched ready to slip.

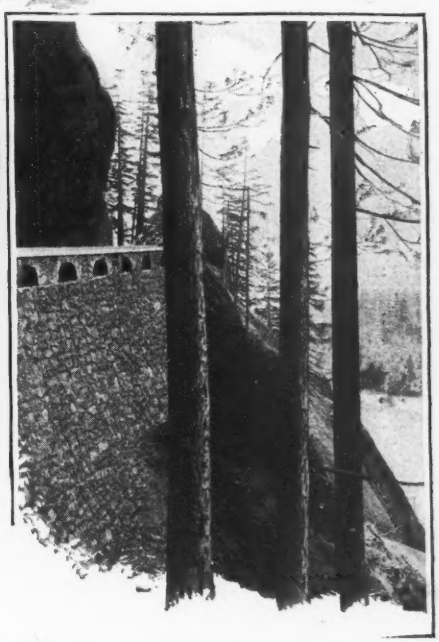
The first work called for tunnels and the highway builders were compelled to make several bores through imposing rock points that rushed skyward hundreds of feet as straight as a plumb line. One tunnel at "Storm Point" is more than three hundred feet long. To insure proper light, arches have been cut through on one side to overlook the river at regular intervals.

Here in the mountains has been worked into perfection the ancient art of dry masonry wall construction. There are approximately two miles of the highway built atop such wall work and all along steep mountain sides. In them each stone was cut to fit and to stay for all time where put.

Instead of the usual steel, reinforced concrete was resorted to in building the bridges that span the numerous torrents. One spanning Moffat Creek is the largest flat arch monolithic bridge in America and the largest three-hinged arch in the world. The clear space of the span is one hundred and seventy feet and the arch rises only seventeen feet in that distance. Another bridge that crosses over a canyon two hundred feet in depth is three hundred and sixty feet long.

One of the biggest problems was encountered in the construction of the highway over slopes where slides threatened. This included work over an immense bed of broken lava rock so restless that it is called "Crawling Mountain." For half a century it alone had prevented a permanent roadway to conect the Inland Empire with western Oregon. The engineers conquered the slides by sinking pillars through the loose super-rock and anchoring to bedrock. On the pillars they built a concrete viaduct just high enough for the slides to thunder harmlessly underneath.

The highest point above the river is attained at Crown Point, a cliff more than seven hundred feet straight up almost from the Columbia.



Oregon's magnificent highway, extending for two hundred miles through the heart of the Cascade and Coast Ridge Mountains, was built by engineers who first spent months in Europe studying famous mountain roadways there. The roadway is nowhere less than twenty-four feet in width and has a grade not exceeding five percent at any point. It is built to last for ages and is considered one of the finest examples of good roadmaking to be found in the country. In the circle above is shown a loop in the road affording a wonderful outlook over the Columbia River, on which the road opens vistas from time to time as it curves through the hills

Oregon Built a Scenic Highway for Motorists

Cripple Makes a Fortune with Tri-Car; Then Runs for City Council

SEVERELY hampered by a disease of the hip which makes him a cripple from his waist down, a resident of Los Angeles has begun life all over again in middle age, succeeding in a new business under a handicap which would have made most men quite willing to depend upon charity. The disease developed to an alarming extent and made crutches essential. At the same period, the physicians declared that life in the open air was the only thing that would save their patient.

So C. E. Ellsworth dropped his former name and for business purposes adopted that of "Handy Andy." He had always liked to tinker with things, and

This cripple made a comfortable fortune as a handy man, and then ran for the Los Angeles city council

the skill of his hands was unimpaired. He was able to outfit a little second-hand car as a traveling machine shop, equipping it with emery wheels, vises and a big grindstone. In this machine he buzzed around town, doing odd jobs for housewives and sharpening knives for butchers.

After some years of hard work, "Handy Andy" bought a neat tri-car well equipped for the work in hand. Now he has succeeded in earning enough to buy a block of flats, and not long ago he entered into a political campaign, winning many votes for a place in the city council, although he failed of election.

Gangway Life-Saver Prevents Crushing of Life Boats

THE hazardous method of lowering life boats into rough water alongside ships in disasters has inspired many inventors to perfect life-saving apparatus that would be really safe.

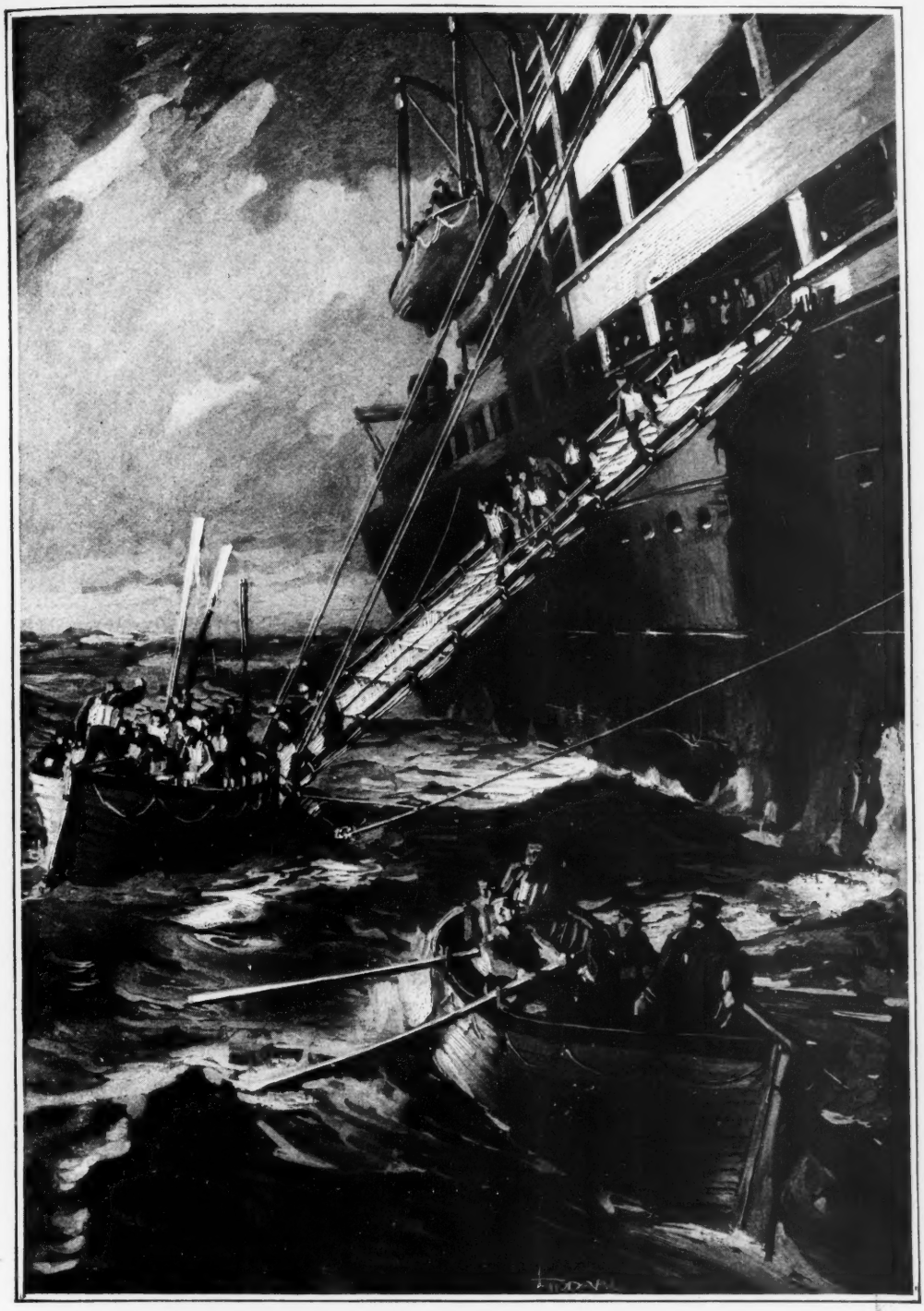
Among the scores of such inventions that have been submitted to the patent office, is a long net gangway which projects from the side of the vessel upon the surface of the water, being supported at the lower end by large air tanks. The poles which support the gangway are hinged to the ship's side, and when not in use are carried in long pockets below the rail of the first open deck.

The chief advantage of this gangway-life saver is that the life boats never approach near enough to the ship's side to be crushed by waves. The boat is held close to the gangway by means of gaff hooks.

A New Device for Recording Sounds

AN apparatus for recording sounds has been devised which, while incorporating some well known principles, has several features of decided originality. The fact that it is possible to retain sounds by other mediums than the phonograph record is not generally known. One device, however, which departs radically from the wax record, is the telegraphone which was brought out several years ago. The telegraphone is a magnetic apparatus, which impresses sounds in their relative strength magnetically on a wire.

The new invention makes use of the telegraphone principle to a certain extent, in that it is magnetic. But it combines a new principle as well—that of photography. A diaphragm alters a shaft of light falling on a moving strip of sensitized paper. When the reel of paper is used, it is copied photographically on a strip of iron. The iron is then etched—in much the same way that half tone plates are etched—and when it passes in its completed form between highly sensitive magnets, the variations in sounds are accurately reproduced in a telephone receiver.



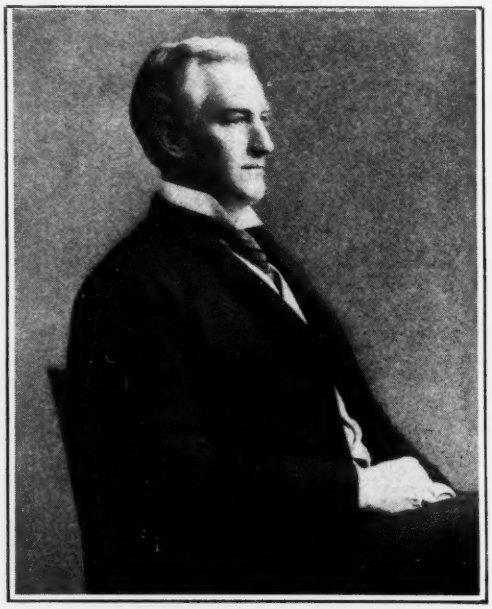
Loading Lifeboats Safely on the High Seas

A canvas gangway let down from the side of a ship, and supported on floats, is designed to allow the loading of passengers without the danger of smashing the boats against the ship's side—an accident very apt to occur

A Really Greater New York

By Dr. T. Kennard Thomson, Consulting Engineer

Dr. T. Kennard Thomson, whose description of his project of a "Really Greater New York" is published herewith, is considered an authority of note on pneumatic caissons. He has designed and built pneumatic caissons for important bridges over many of the great rivers of the country, in addition to having been retained as a consulting engineer in the construction of over twenty New York skyscrapers. During his experience he has underpinned buildings as high as eighteen stories, putting in new foundations with the slightest possible settlement, although sometimes the new foundations were sixty feet under the old. Dr. Thomson was one of the board of five consulting engineers in charge of the New York Barge Canal in 1914-15, and is also the man who conceived the project of building a new dam in the Whirlpool Rapids, near Niagara Falls, which we described in our November issue. —EDITOR.



Dr. Thomson is an engineer who thinks in large masses, and then arranges his detail to solve the problem he has created

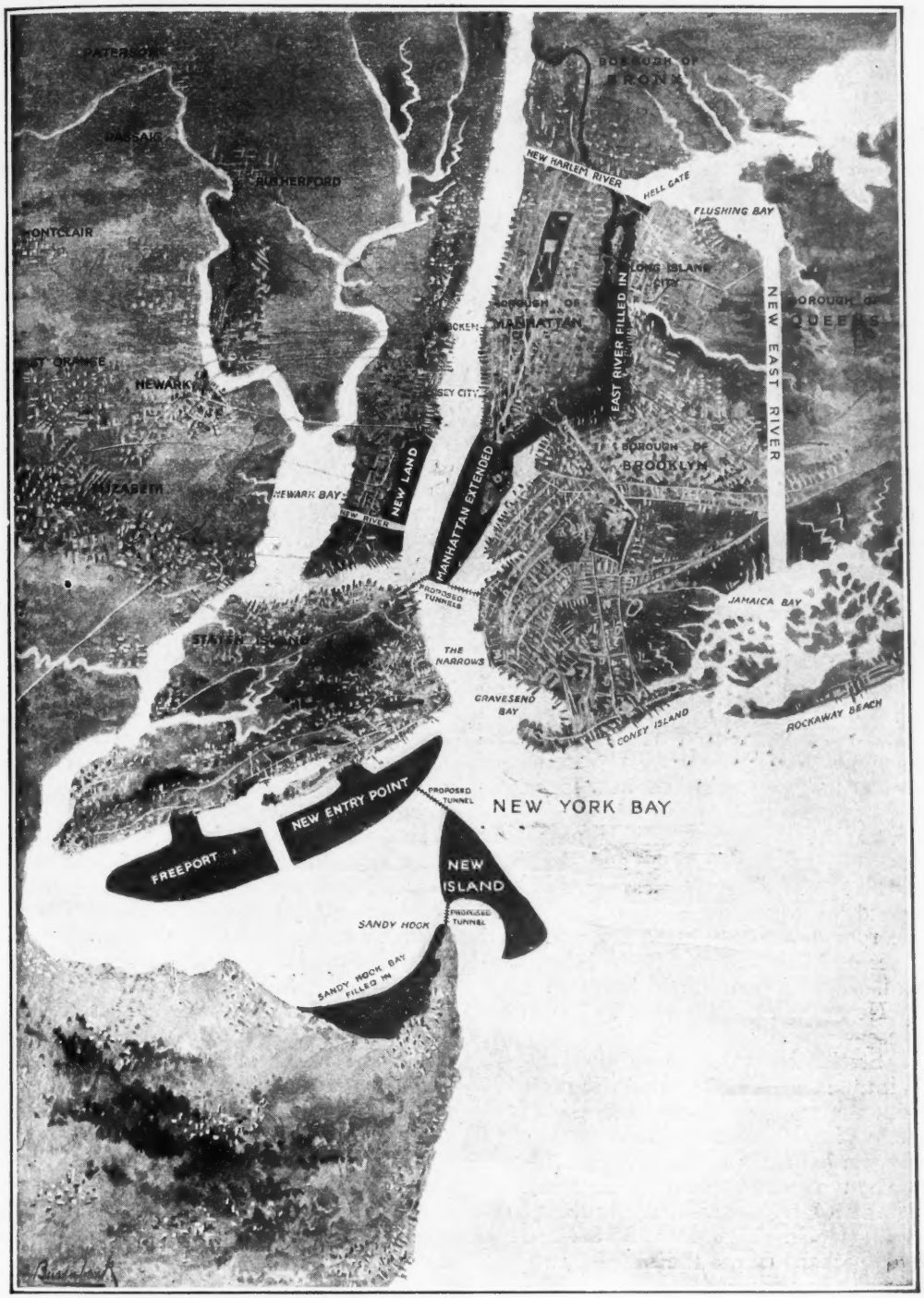
AT first glance, a project to reclaim fifty square miles of land from New York Bay, to add one hundred miles of new waterfront for docks, to fill in the East River, and to prepare New York for a population of twenty million, seems somewhat stupendous, does it not?

One hundred years ago Gouverneur Morris, Simeon De Witt and John Rutherford spent four years laying out New York, and went on record as saying that "the country north of One Hundred and Twenty-first Street would never be covered with houses for centuries to come." Now apartment houses extend to Yonkers, to White Plains and to New Rochelle. New York's overflow has made of Brooklyn a great city. New subways are constantly being built, yet are inadequate when they are completed. Twenty-five years ago New Yorkers felt sure that their water-front would be sufficient for their purposes for many years. Today engineers are searching for some method to cut the Gordian knot of New York's harbor congestion problems.

It is hard to realize the enormous strides of the past century, and still more difficult to comprehend the needs of the future.

Now I propose to add, by a series of engineering projects, fifty square miles to Greater New York's area and port foothold. At the same time this will mean an addition of one hundred miles of new water-front. New York's City Hall would become the center of a really greater New York, having a radius of twenty-five miles, and within that circle there would be ample room for a population of twenty-five millions, the entire project to be carried out within a few years. Many have said "It can't be done." The majority of engineers, however, have acknowledged the possibility, and I have received hundreds of letters of encouragement.

Although this would mean an expen-



An Engineer's Plan to Make New York Bigger

A bird's eye view of the Really Greater New York as it will appear if Dr. T. Kennard Thomson's project is completed. The black spaces show new land of immense value recovered from the harbor and the East River

diture of a great deal more than the sum involved in the construction of the Panama Canal, the returns would quickly pay off the debt incurred, and then would commence to swell the city's money bags, until New York would be the richest city in the world.

By carrying out this vast project in stages, each complete in itself, the returns would pour into the city treasury even while the engineers were working, and thus save much money to the taxpayers.

The first step would be to build parallel coffer dams, about half a mile apart, extending from the Battery to within about one mile from Staten Island, and then connect the ends of these coffer dams by another coffer dam. The box-like space formerly these three coffer dams and the Battery would then be filled with sand up to about the low water level.

A clear, vertical space of at least fifteen feet should be left above this level, and below the street level, for sets of real rapid transit subways, conduits for electric power service, trunk sewers and all of those underground pipes which are an important part of the city's welfare, so that it will never be necessary to tear up the street to get at these necessary arteries of our city life.

Imagine the value of this new land for docks, warehouses and business blocks! The tax assessments alone would make a fortune!

From the new Battery, I would build a set of tubes and tunnels to Staten Island, bringing that land almost as close to New York as Jersey City is at the present time. Today the assessed value of Staten Island is about $50,000,000. With the completion of the land reclamation, the property value would not fall short of $500,000,000. This would help pay the expenses of the project.

The next stage would be the construction of a large island flanking the tip of Sandy Hook. Next I would make upon Old Orchard Shoal the first of two extensive areas which, when joined to Staten Island, would form a large enclosed basin, and in addition to this would afford protected dock frontage on several sides. The shallows just within and contiguous to Sandy Hook would be filled in, making a large new area.

The projects I have just mentioned would reclaim some forty miles of new land, which would be a maritime Pittsburgh, the greatest export manufacturing center in the world. In this new harbor, protected from the ocean by the new island off Sandy Hook, there would be docking facilities for the world's largest ships. There would be dock yards, dry docks, ship yards, coaling stations, which would make all of Staten Island a great industrial beehive.

Naval authorities agree that the East River is no place for the Brooklyn Navy Yard. In Newark Bay, after the completion of the operation, would be a great, protected Navy Yard, with ship yards and dry docks enough for the dreadnoughts of the future. A new river, cut straight through to Newark Bay, would form an ample entrance to the new Navy Yard.

My next step would make still greater changes in the topography of New York. I would construct a new East River, forty feet deep and one thousand feet wide, from Jamaica to Flushing Bay. While this is under construction, I would lay tunnels and rapid transit tubes beneath it. There would be no bridges over the new river. On the same plan I would cut a new Harlem River from Hell Gate to the Hudson. By means of these straight and wide rivers, our entire fleet of battleships could proceed from the new Navy Yard into Long Island Sound within a short space of time. At present they have to steam all the way around Long Island, as they cannot go through Hell Gate safely.

I would build a dam at Hell Gate and another just above the Bush Terminals. Heavy concrete coffer dams would prevent the land from slipping when the water was pumped out. Where rock is within a reasonable distance from the surface, and the bed of the river has been laid bare, I would not fill it with earth, but from the basic rock of the river bottom I would make concrete pillars carry highways and business blocks much after the fashion of the Grand Central Terminal.

In the space below the street level I would leave ample space for subways, for sewers and pipe lines. No digging

The rows of trenches are not structures built by warring soldiers, but are the terraced rice-fields of industrious Filipino farmers

would have to be done, they would simply be laid on supports, and great subsequent expense would be saved.

As a result of this construction it would not be much harder to get to Brooklyn than to cross Broadway. Indeed, New York and Brooklyn would be as much one big city as are the East Side and the West Side. New York would expand logically. At present most of the expansion is to the north of the city, and forms its chief problem.

This practically completes my scheme. I do not urge the simultaneous attack of the entire project. It should be carried through section by section, and this would involve an annual expenditure of from fifty to one hundred million dollars.

When these facts are understood there will be no difficulty in obtaining the necessary authority to start work. Then, after the section between the Battery and Staten Island has been laid out on paper, enough land can be sold to start the work, which would proceed just as fast as the proceeds of the sale justified, and a really great debt-free New York would result.

Farming on a Precipice

ON mountain slopes so steep as to appear quite worthless for agriculture, the rice growers of the Philippine Islands are producing crops upon made-to-order farms. These famous terraces of the Mountain Province extend as far as the eye can reach, a work of patience rivalling the pyramids. Imagine a whole mountain laid out in ledge above ledge, the walls almost perpendicular, the strip of field graded just enough to allow the water to flow from one terrace to another without violence, so that every acre is irrigated but not washed out by the current.

As the photograph indicates, the work appears too vast to be the work of human beings. In fact it might better represent some great upheaval of the earth's crust.

EXPERIMENTS are being carried on in Cuba with the fiber of a plant locally known as *malva blanca,* which is said to produce an ideal fabric for sugar bags.

The February Popular Science Monthly will be on sale Saturday, January fifteenth (West of Denver on Thursday, January twentieth).

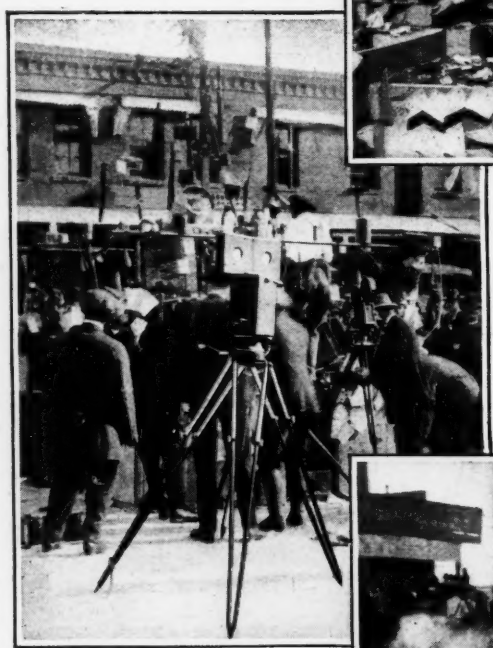
Five Thousand Dollars a Minute.

AFTER a crusade of about six months, the police of Los Angeles, Calif., have destroyed the results of their successful raids on opium dens in an immense $25,000 bonfire, the flames of which were fed by confiscated marihuana, contraband opium and "hop" pipes. This strange fire was ignited by inspectors for the State Board of Pharmacy at the Plaza in Los Angeles, Calif.

The motion picture companies all sent men to the spot. A battery of cameras was set up. One of the accompanying pictures shows three cameras busily taking "close ups" just before the match was applied. Several more cameras are in the background.

One ton of marihuana or "Indian hemp" was put on the fire. Marihuana is a weed with narcotic properties, is closely akin to hasheesh, and is smoked when dry. It is in particular favor with Mexicans. A ton of it at retail prices would bring $16,000. A great number of tael cans of opium appraised at about $7,000 furnished additional fuel. Among the confiscated goods were fifty opium pipes.

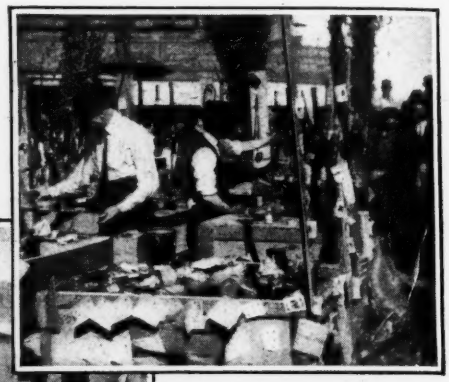
One was taken from an old Chinaman who had smoked since he was a boy. He was convicted in court and paid his fine without a murmur. But when the officers told him his pipe would be confiscated, tears came to his eyes. He offered first $50 for its return, and then by jumps of $50 each brought the price up to $400.



Half a dozen cameras lined up to film the big little fire

Hundreds were at the scene of the fire, some drawn by curiosity, others to take a farewell look at the precious burning dream-stuff.

The officers placed big wooden boxes in a square and then set pipes,



Hundreds of heartbroken "dope fiends" watched the preparations. In the picture below the flames are reaching for the precious opium pipes, destroying the lottery tickets and filling the air with the soothing fumes of opium and marihuana

cans, bottles, trays and small boxes of the "dope" on them.

Wires were strung around the square and the pipes were hung in a row. On the boxes also, were scattered paper slips with Chinese characters on them. These were confiscated lottery tickets.

The officers poured on coal oil and applied the torch. In five minutes it was a pile of tin cans and ashes.

Risking His Life to Make a Motion Picture Play

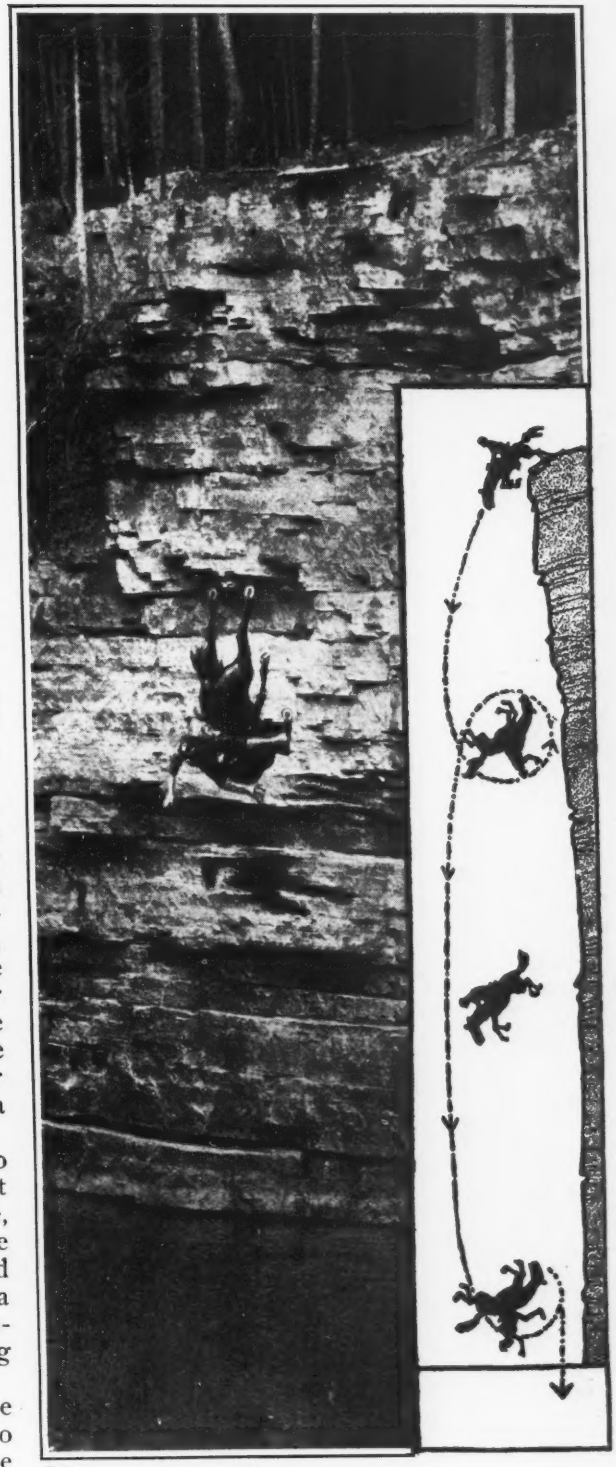
ONE of the most spectacular feats ever shown on the films was recently recorded when a horse and its rider dived eighty-three feet from the top of a cliff into a pool of water. This performance was invented by a director who wished to inject realism into the film version of "Carmen." The results in the picture were highly satisfactory, but the results to the actor were unfortunate.

The plot of the story demanded that Carmen's lover should commit suicide by diving with his horse from a high cliff. One of the most daring of the actors was selected for the feat. After a long search a suitable spot for the act was found in the Adirondack Mountains. The cliff chosen towered eighty-three feet above a pool of water, the bottom of which was studded with sharp rocks.

The actor, when all was ready for the filming, with a battery of camera men waiting on the opposite bank, drove his horse to the edge of the precipice and urged the frightened, trembling animal over the brink. The horse was wiser than the actor, however, for he could not be driven to make the plunge. At last another steed was chosen, this time, a trained diving horse.

Even the horse trained to the work refused at the last minute to make a clean dive, and while it hesitated on the edge the daring driver spurred him over. The fall was not a clean one, and the horse somersaulted twice during the long drop.

The catapulting drop made it impossible for the actor to throw himself away from the horse, and the two struck together on their backs and disappeared from sight.



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The perilous feat of a motion picture actor and his horse. The horse was not hurt by the 83-foot drop, but the actor was seriously injured

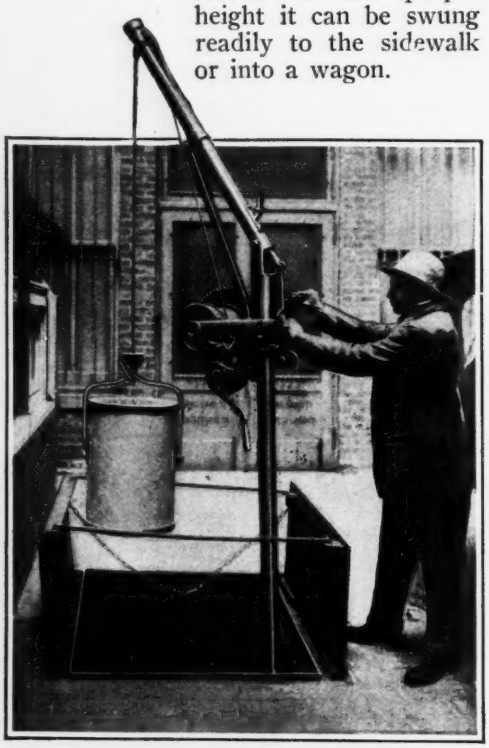
From Cellar to Sidewalk

HANDLING ashes, ice and boxes between the sidewalk and the basement is often attended by much heavy lifting and the usual employment of two men, or is done with a clumsy elevator. With a new hoist shown in the illustration this work is accomplished by one man and more rapidly than it could be done even with an elevator.

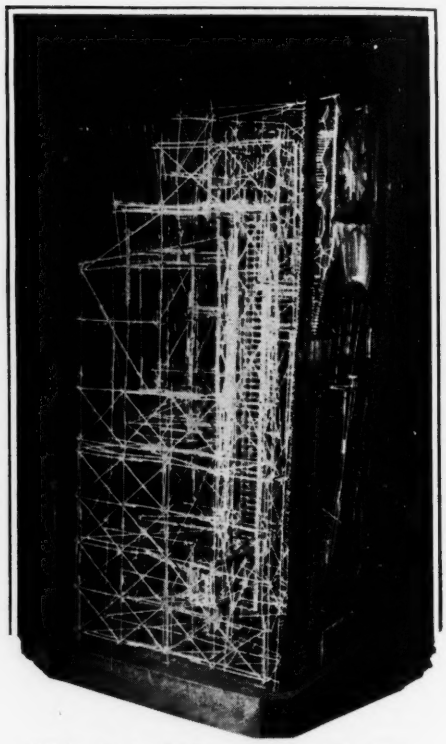
When not in use the hoist mast telescopes and is wholly contained below the basement doors. When it is to be used, a handle in the basement is turned and the mast automatically raised to the required height where it locks itself.

The operator can now raise ashes or other heavy articles out of the basement by turning a handle on the side of the hoist within easy reach from the sidewalk level. A pressure of seven pounds on the handle will raise one hundred pounds on the end of the cable.

The upper part of the hoist is on ball bearings so that when the weight is raised to the proper height it can be swung readily to the sidewalk or into a wagon.



Rubbish removal is slowly being modernized. Here is the newest form of collapsible derrick for city houses



This clock, built entirely of straw, manages to keep accurate time in spite of its flimsy fabric

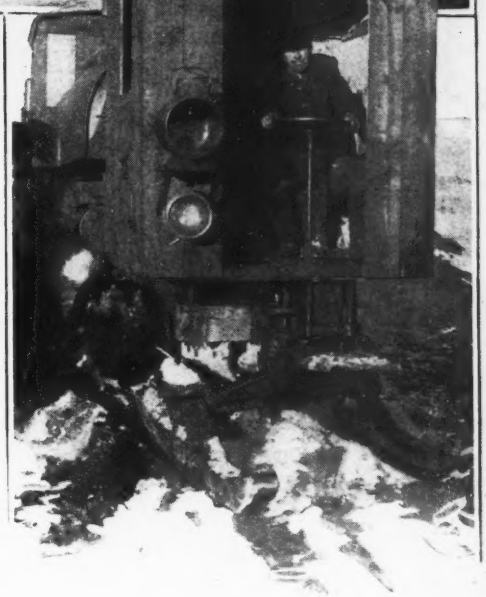
A Clock Made of Straw

A CLOCK made in Germany is constructed of nothing but straw. Not even a piece of stiffening cardboard or a drop of glue has been used. It is six feet high and is two feet square. There are eight pendulums which allow speed regulation. By pressing a button which comes out automatically on one side, the clockwork is wound up and runs for five hours. By pushing another button, the hands can be set. The dial, figures, pendulum, hands, even the chain, weight gears and the skeleton are of straw. The chain is fourteen inches long and endless. In the construction of this clock, thousands of stalks of straw have been used, mostly three and four fold to give greater strength.

Shooting at Jupiter

IT is reported from France that Jupiter, which has been especially brilliant lately, has often been mistaken for an enemy airship flying over Paris, and that guns have been trained on it.

A steam tractor helps reduce logging costs in the Maine forests. Caterpillar wheels support the tractor on the snow



Logging with Tractors in the Maine Woods

LOGGING has remained for generations the most primitive of all modern operations. The logging railroad is a comparatively recent development, but even that falls far short of being an active agent in reducing the vast waste necessitated by the fact that only such timbers can be moved out as will pay for expensive transportation. In the tropics a mahogany log worth hundreds of dollars in New York is valued at only a few demonetized dollars as it stands in its forest, and almost priceless hardwoods are left to rot or burned up in the clearing of ground simply because they cannot be "squared" to the formal size, about one foot on each side.

To a lesser degree the same problem faces the timber cutter in the forests of our own country. The long hauls through the woods to streams or roads, even to the roughest sort of logging roads, is discouragingly expensive, and from there to the railroad or mill entails another long haul with primitive means, either oxen or horses.

Modern power appliances are, however, slowly coming into use as they prove their worth. In certain sections of the Maine woods, where logging is the winter occupation of farmers from nearby sections, tractors are now in use. The drive on these engines is by caterpillar wheels, broad enough to keep from sinking into the snow, and the forward part of the tractor is mounted on sleigh runners, which are turned by hand to guide the tractor and its train of logging sleds.

The tractor is crude in a way, but it can reach sections of forest country to which even the ordinary logging railroad, with its clumsy engine, cannot readily penetrate.

In the tractor shown here, the runners at the front make steering easy and accurate. The unwieldy front wheels of the ordinary tractor would hardly serve in the forest.

Mercury Poisoning and Deafness—The Price of a Derby Hat

By A. M. Jungmann

WHEN you pay five dollars for your fine derby hat do not imagine you have paid the price of the hat. The real price is paid by the unfortunate victims of "hatters' shakes" who contract mercurial poisoning while engaged in preparing the fur and making it into your hat.

There are many trades which are dirty and hazardous but it would be difficult to find one as objectionable as the hatters' fur trade. From the moment the fur receives a scrubbing with a solution of nitrate of mercury until the hat is finally completed, mercurialism is a constant menace to the workers.

Conditions found in various factories differ greatly. In some, every effort is made to protect the workers and in others the welfare of the operatives is neglected. The Department of Health of New York city recognized that thousands of workers in our industries are subjected to conditions which endanger their health. As a means of protecting the workers and raising the standard of the public health, the Department opened an Occupational Clinic and concentrated its energies first of all on the fur and hatters' fur trades.

In the preparation of the hatters' fur used for the manufacture of felt hats, rabbit, coney, nutria, muskrat and hare skins are put through a number of processes. The skins are received in the factories just as they have been stripped from the animals by the trappers. They are stiff and full of natural animal grease and dirt. The skins are first cut open by unskilled laborers. They are then combed and brushed by hand. The brushes used for this purpose have fine wire bristles. With this brush the workman frees the fur from particles of dirt. Anything which is not readily removed by the combing and brushing process is removed with the aid of a very sharp knife. In some cases the skins are brushed by machines supplied with suction devices. Where the work is done by hand the air is full of fine dust and particles of fur. It is the usual practice to have a man employed all day in sweeping up the accumulated dust and dirt from the floor with results that can be imagined.

After the skins are combed, they are dampened and the long hairs are clipped or plucked. In the case of hare skins the plucking is done by machinery; with coney skins it is done by hand. The hand plucking creates an immense amount of dust, hair and fluff in the air.

The occupational clinic where the workers in trades which give rise to occupational diseases are examined by the New York City Department of Health

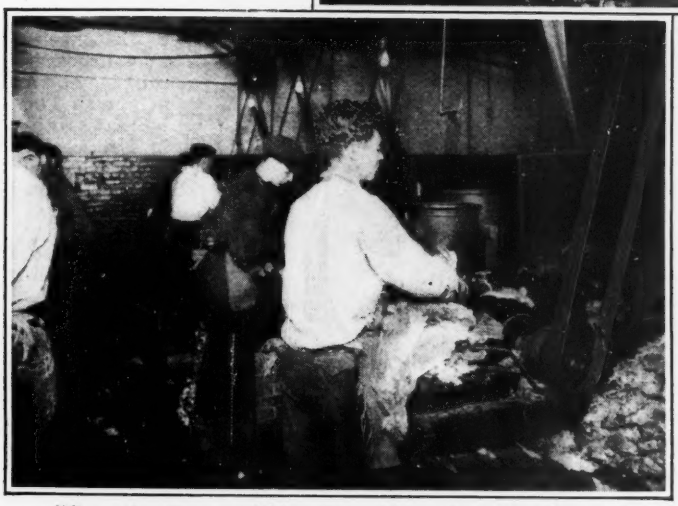
Frequently the workers stand in a mass of hair, which covers the floor to a depth of several inches. The skin is fastened over a leg stump by means of a loop of clothesline which is held taut by another loop through which the plucker places his foot, as in a stirrup. This causes the worker to assume what would

seem to be an almost impossible posture. The toes of the left foot, which is in the stirrup, barely touch the floor and the worker is forced to lean foward and press his abdomen against the upper pole of the stump that he may retain his balance.

In the case of plucking machines much of the danger to health is eliminated because the plucking machines are supplied with suction devices which carry off the loose particles of fur and dust.

The next treatment to which the skins are subjected is the most dangerous one. It is known as carroting. The pelts, with what fur remains on them after the long hair has been removed, are placed on a table and scrubbed with nitrate of mercury solution. This gives a brilliant yellow color to the light parts of the fur. Hence the name. In some instances this work is done by hand and in others by machinery.

Combing rabbit skins to remove particles which may be lodged in the fur. A good workman combs twelve hundred of these skins a day



"Carroting," or scrubbing the rabbit pelts with nitrate of mercury solution. It is the use of this nitrate of mercury which constitutes the greatest hazard in the fur felt trade

When carroting is done by hand the workman holds the pelt on a table and scrubs it with a brush which he dips in the mercury solution. When it is done by machinery he holds the pelt on a revolving brush which passes through a bath of mercury. In either case it is necessary for the workman to wear strong gum gloves to protect his hands from the mercury solution.

The carroted fur is now taken to drying rooms where it is placed on racks and dried in ovens. When the mercurial solution has been volatilized the skins are put through the shaving process. Machines cut the hair from the skins and deposit it on metal trays. Girls sort out the hair of the various parts of the animal's body and place it in groups. The skins, when they are denuded of hair, are used to make glue.

It is impossible to describe the noise of the cutting machines. Unless a person has leathern lungs he cannot make himself heard in the cutting rooms, even if he shouts close to your ear. The girls who sort the fur are for the most part young. The workers suffer from defects of hearing brought on by the unearthly clatter. Some of the workers who were found to be perfectly devoid of hearing

told the doctor at the clinic that if they remained at home for two days they generally regained some of their ability to hear. If Dante could have visited a cutting room he might have described another torment in his inferno. In looking over a roomful of young girls whose deft fingers never falter in sorting out the fur one is astonished that they can retain their composure in that unspeakable bedlam. And one wonders, after all, if any felt hat is worth years of deafness.

But, deafness is not the only danger, for every one who handles the fur after it has been carroted faces the menace of mercurial poison. Three hundred and fifty employees of the hatters' fur trade were examined through the Occupational Clinic. Of these fourteen per cent. were indisputably suffering from mercurialism. Many have violent tremors of the hands, face and tongue. Unfortunately most of the workers fail to realize the danger of their occupation, and it is exceedingly difficult to get them to observe the first principles of self-protection against the hazards of the trade. In some instances it was found that the employer had to lock the carroting rooms and the drying rooms at noon time to prevent the employees from eating their lunches there.

The constant breathing of dust and fur-laden atmosphere affects the nose, throat and lungs of the workers. This could be obviated by sweeping after hours or by the employment of a vacuum device. But no matter how much may be accomplished through cleaning up the factories and installing safety devices the condition of the workers cannot be very greatly improved until they themselves are made to understand the peculiarly dangerous character of their work.

The use of mercury in the hatters' fur trade causes much suffering among the workers but it is something which must be tolerated until such time as someone invents a felting process which is as good and as cheap as that dependent on mercury. Only mercury can roughen up and flare out the laminae of the fur fibres which causes the fur to snarl readily and to form felt satisfactorily.

Street Corner Directories That Tell You Everything

WHEN you are in Los Angeles, Calif., and Seattle, Wash., and you want to know the location of office buildings, etc., you have only to go to the nearest street corner to find a directory on the side of the building giving the location of business houses, office buildings, and a list of street cars which pass the corners within three blocks from that point, and their routes and destinations.

The street corner directories of Los Angeles know almost as much as a policeman. The buildings within a radius of two blocks, the car lines that pass the corner, and where they go, are all set forth graphically

These directories are changed or added to every month. They are large cards covered with glass and in a metal frame.

Over one hundred of them have already been placed and the list is being added to rapidly. This system relieves the traffic policemen stationed at the intersections of the streets, leaving him free to attend to the regulation of the automobiles.

Band Concerts from an Electric Light Bulb

By George F. Worts

MUSIC that ranges from the piercing wail of a taut violin string to the grumbling bass of a monster horn has been added to the remarkable achievemnts of an electrical instrument so small and so insignificant in appearance that it could be passed by scores of times without arousing so much as a lingering glance.

Despite its innocent appearance, however, its technical name is more than formidable. Scientists know it as the "oscillating vacuum tube," although this name has been changed and shortened to a simple compound word, "audion." "Audion" is derived from audio, to hear, and ion, the tiniest division of electricity; in other words, to make audible the action of ions. This, in a word, is exactly what the oscillating vacuum tube accomplishes.

Before proceeding directly to a discussion of the latest marvel of the audion,—electrical music—let us pass hurriedly over some of the achievements that have preceded it, which, in a round-about way, have led to the discovery.

Amateur and professional wireless operators know the audion well, although numbers of them are not aware that it has other uses than the reception of radio signals.

Connected with the proper wireless instruments, the audion will receive and strengthen the weak signals of a distant radio station to a degree several times as loud as any other detector. But its ability in this direction does not stop there. If several of the tubes are connected in the correct way and adjusted with great care, the wireless signals will be increased in loudness several hundred times. This arrangement is known as the Audion amplifier.

In both of these uses, the construction and operation of the audion are practically the same. In fact, for all of the uses to which the audion is put, its fundamental structure, apart from size, does not vary. In appearance it closely resembles an ordinary electric lamp bulb. There is a brass base with threads, so that it can be screwed into a socket, a round glass bulb and a filament burning brightly in a partial vacuum. But beyond this point, the audion and the electric light are strangers.

Built into the bulb close to the filament are two metal electrodes. One is a tiny replica of the grids that are used in coal stoves . . . . and it is called a grid; while the other is a small plate. The grid and the plate are connected to the other apparatus in such a way that a perfect balance, electrically speaking, is maintained between them. When an outer influence, such as an incoming wireless wave, is brought into the bulb, this balance is disturbed, and in a strengthened form, the disturbance is heard in the telephone head receivers as the dots and dashes of the wireless code.

Dr. Lee DeForest, inventor of electrical music, and his audion bulb

Strange to say, this same balancing principle is made use of in another application directly opposite in na-

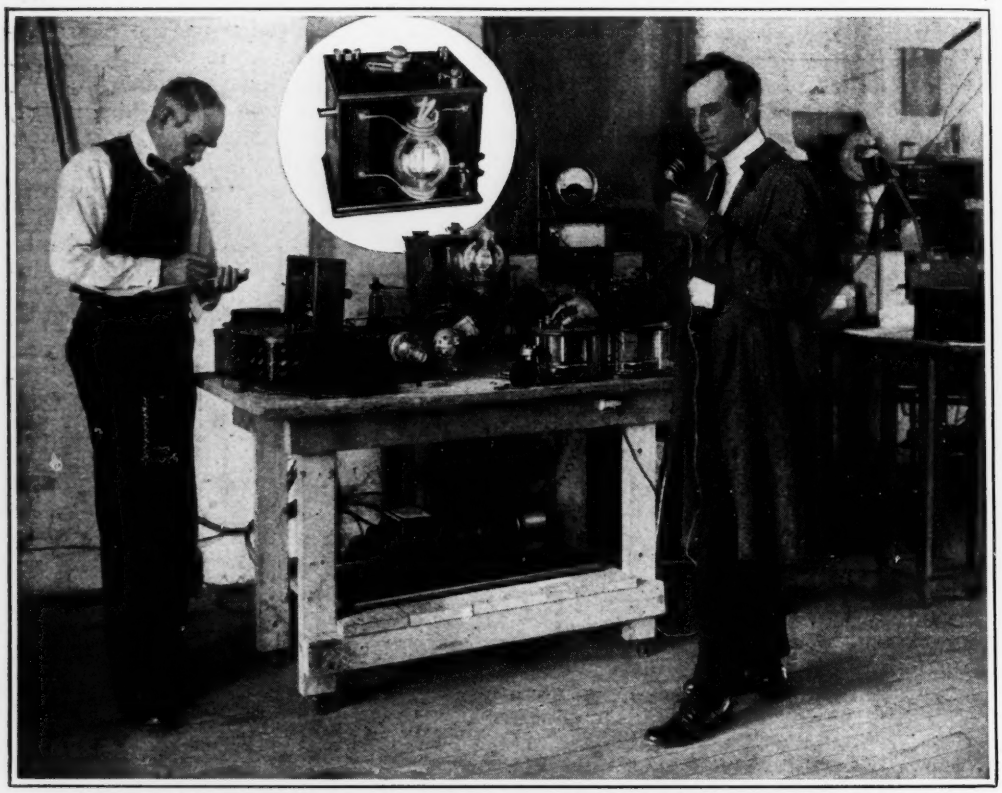
ture to the foregoing, when the vacuum tube is employed as a wireless telephone. Hundreds of the bulbs are connected to a powerful battery or dynamo. The voice spoken into a telephone transmitter connected in the circuit so disturbs the electrical balance of the bulbs that powerful waves are created. The most striking example of this application was the recent feat of telephoning wirelessly from Washington to Hawaii.

Another use of the audion is in relaying the current that carries the voice over long distance telephone lines.

The other applications of the audion are of a laboratory nature. One of these applications is transforming electricity. By throwing a small lever, the outgoing current can be varied from fifty to more than a million vibrations a second.

By the combination of some of the foregoing properties of the vacuum bulb, the uncanny but delightful result, electrical music, is attained. The idea of converting the silently flowing electric current into strains of the most bewitching music is not entirely new. Many readers will recall the telharmonium, which was built at great cost several years ago and with which electrical concerts in the home were prophesied. But the telharmonium required dynamos of such variety and size that it was eventually given up because of the prohibitive cost. Music from electricity—or music from light, to be exact—goes back many years before the telharmonium. Legendary Egyptian history, three thousand years old, tells us that the rays of the descending sun, would strike weird music from the face of the statue of Memnon.

Incredible as this tale may seem to



In appearance the audion closely resembles an ordinary electric lamp bulb. Built into the bulb close to the filament are two metal electrodes which are connected in such a way that a perfect electrical balance is maintained between them. When the wireless wave disturbs this balance, the disturbance is heard in the telephone receivers

us now, the present day accomplishment of electrical music is hardly less astonishing. To an ordinary audience, the fact of most striking importance would be the quality of the music. It is quite possible to imitate the mellowest tones of a Stradivarius violin, but more interesting still, it is possible to create music of a tone and timbre that no one in this world has ever heard before. No less strange than the quality of the music is the means by which it is obtained. The variations produced in an electrical circuit by inserting a lead pencil line drawn on paper will cover not only the complete octave, but will include the most infinite shadings in tone.

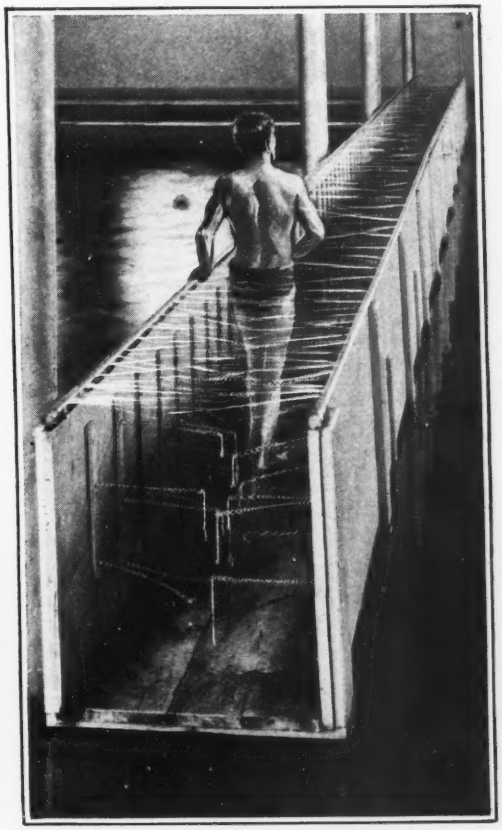
Dr. Lee DeForest, the discoverer of this type of electrical music, claims that with an arrangement of four or five bulbs and suitable adjusting apparatus and keys similar to those of a piano keyboard, he can easily obtain notes ranging in pitch through as many octaves as are desired and a tone quality identical with that of all musical instruments now in use as well as qualities never before produced.

The volume of sound depends upon the adjustment, the number of batteries that are used and the size and number of electric horns which project the sound. The horns can be distributed in various parts of the room or grouped together.

The basic principle involved in creating music by a vacuum bulb, Dr. DeForest does not attempt to explain. Nor does anyone else. Perhaps it is due to the unbalancing action caused by interference with the flow of the current. In this case, the tiny particles of electricity loosened, bombard the grid and the iron plate in musical rhythm. At all events, the action is probably highly complicated, and it may involve some new principle of electricity that we have not yet learned.

A Walking Leg Bath

AN interesting and unusual way of using water as a curative measure is represented by the "walking leg bath" evolved by a Battle Creek sanitarium and included in its list of helpful apparatus.



Tingling streams of cold water bring the blood rushing to impoverished muscles as a patient walks through this leg bath

The walking leg bath is a simply constructed frame, lined with a number of woven wire springs and equipped with two water pipes, perforated at inch spaces to permit a horizontal shower. This strikes the legs at the moment when the muscles are in action and most open to benefit.

The patient is told to walk through the bath briskly, and by the continued performance of that act alone he improves his condition, the wire springs against which he must brush in passing, insuring a brisker circulation. The needle-like streams of water—at varying temperatures—forced against his legs by air pressure heighten the effect. It is one of the most exhiliarating of the modern "cures."

The walking leg bath is recommended in certain forms of rheumatism, varicose veins and other maladies affecting the lower extremities.

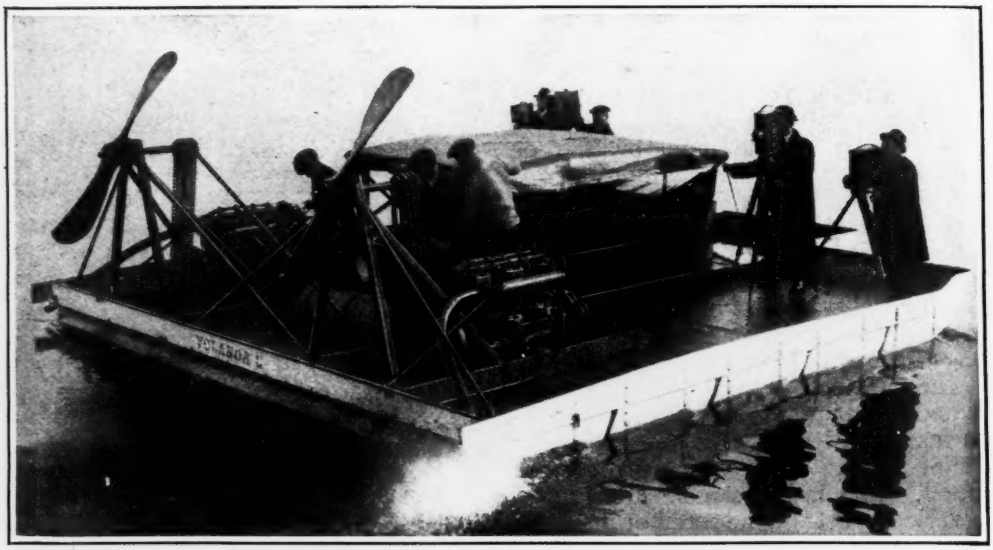
Gliding Boat for Tropical River Mail Service

A GLIDING boat that speeds over the water at the rate of fifty miles an hour has been built for transporting mails on the Magdalena river in Columbia, between the Carribean coast and the capital city, Bogota, a distance of six hundred miles. On her trial trip, from the factories at Nyack, N. Y., to the foot of Ninety-first Street, New York, a distance of twenty-two miles, the "Yolanda II" covered the distance in less than a half hour.

The Steam Engine in War

THAT the Lanz locomobile, the name by which a remarkable portable superheated steam engine is known, is equally as successful for war as well as peace purposes is convincingly shown by its behavior during the past year on the various battle fronts.

One of the most interesting applications of the locomobile is for power purposes in connection with field equipment, such as wireless telegraph sets. One locomobile is supplying energy to a two hundred horsepower field wireless equipment. The locomobile is used extensively in operating pumps directly behind the firing line. A more extensive use is in supplementing the power plants of ammunition factories.



This gliding boat, which takes its power from the displacement of air instead of water by its propellers, was built in New York for use on a tropical river, where weeds make the use of screw propellers in the water impossible

Two gasoline engines of one hundred and fifty horsepower each are connected to an air propeller. It is impossible to use screw propellers in the Magdalena, as the sea weeds and grass are so thick.

The Yolanda II draws three inches of water while speeding at a rate of fifty miles an hour, and five inches while at rest. She was designed by Gonzalo Mejia, an engineer of Columbia. The problem of transportation on tropical rivers, where the shallow draft of encumbering sea weed, makes a draft of more than a few inches impracticable, has engaged the attention of native engineers for years. Mr. Mejia's boat is one of the best devices yet built to meet the problem.

In one plant two locomobile units of five hundred horsepower each were added; in another, which, before the commandeering of the fuel oil supply, had been employing oil engines, a single one hundred and twenty horsepower locomobile engine supplanted the entire power equipment.

Among other applications of the locomobile are hauling guns and ammunition trains to the various batteries, and in heating hospitals and prison camps with the hot water from its boilers.

A motorcycle on runners is a novelty, but its practicability has been proven

A Sleigh Motorcycle.

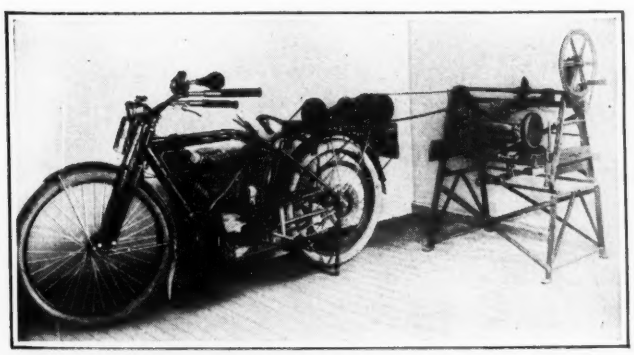
ALTHOUGH it is possible with little snow on the ground to run a motorcycle with its rubber tires, it has been found impossible to do so when the fall measures several inches, and a resident of Galt, Ont., has solved the problem thus presented.

The rubber tires were taken off the front wheel of the machine, and off the wheel on the side car, and runners were fitted on, and bolted to the rims of the wheels. The rubber tire remains on the rear wheel of the machine for driving purposes, but the runner on the front wheel makes the rut, thus permitting the use of the one tire.

Keeping the Motorcycle Busy

BY applying a belt and pulley device to his motorcycle, a mechanic who runs a grinding establishment has been able to double his output in the last season, the motorcycle supplying the power to grind lawn mowers, and the like. Fans driven by the same power keep the engine cool, so that it can run many hours without overheating.

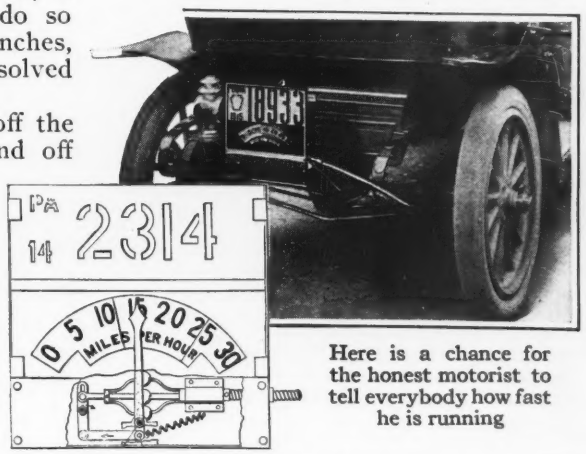
The device was constructed by W. M. Conover in his shop in Gettysburg, Pa., and is a complete success. Of course the motorcycle is of value to him in securing business, and the belt and pulley attachment can be removed with no trouble in a few minutes' time.



The mechanic owner of this motorcycle keeps it at work in his shop turning a lathe

Indicator Tells Pursuing Police Speed of Automobile

LAW-ABIDING motorists who have had the disagreeable experience of being arrested when they were well within the limit of the law will doubtless greet, with delight, the new invention of a Pennsylvania inventor. By means of a speed indicator, similar to the indicators which are found on the instrument boards of nearly every car, the inventor has made a combination license tag holder and speed indicator which shows clearly to the public the number of the car, as well as the exact speed at which the car is traveling.

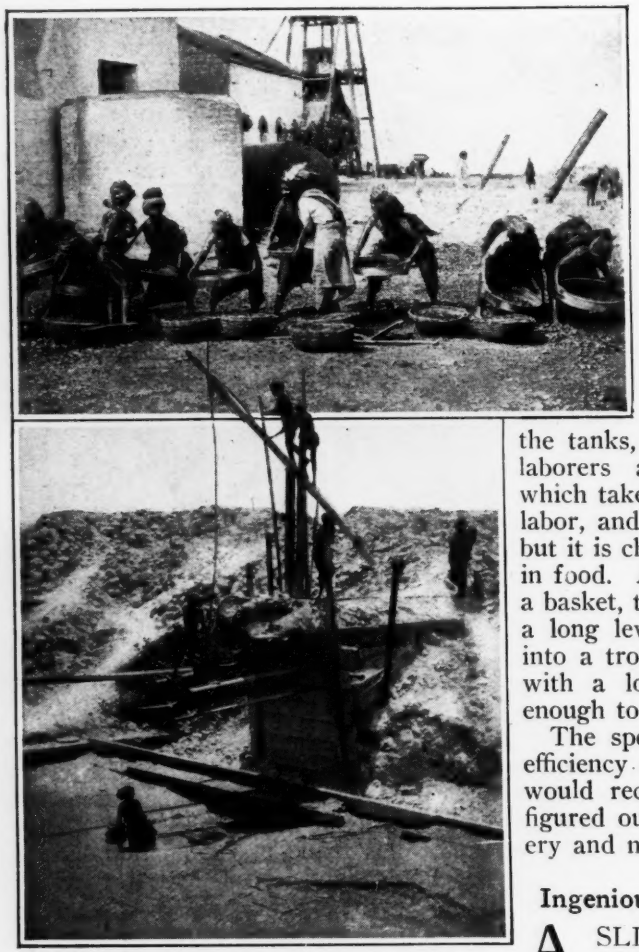


Here is a chance for the honest motorist to tell everybody how fast he is running

A semicircular plate, with the numbers in multiples of five up to thirty miles an hour, is equipped with a pointer, which indicates accurately the speed of the car. Both the license tag and the indicator plate are perforated, and are illuminated at night by means of a light placed behind them.

Where Men Are Still Cheaper Than Machinery.

GREATEST good to the greatest number makes some strange customs in India. The inhabitants are numbered by millions, and they are so pinched for money that a little has to go a long way. The companies operating gold mines there find it the best policy to hire all the labor they can, both because it is cheaper than installing labor saving machinery and because by that means they can save many from starvation.



Machinery would be used to sift ashes and pump slime in modern communities, but in India hand work is cheaper

Wages are extremely low and workmen are often very intelligent, performing exceptionally good work. Raw material is cheap, too, and the combination effectually bars out modern progress. For instance, the trains of ore cars are hauled by bullocks. An aerial tramway was installed by an enterprising manager, but he soon found that his maintenance charges were much greater than the total freight costs when the bullocks were used. Back came the bullocks and their native drivers.

Instead of using machinery, women and girls are employed to sift the ashes and recover small particles of unburned coal. The system is cheap and effective. So is the handling of slime pulp from the mills. This is a fine, slimy mud which is settled in big stone tanks in order to recover the water from it.

In progressive countries heavy pumps are used to empty the settled mud from the tanks, but in India they use native laborers and a primitive mechanism which takes much more time, uses more labor, and is not nearly so satisfactory, but it is cheaper and keeps many natives in food. A woman scoops the mud into a basket, two men raise it on the end of a long lever sweep, another empties it into a trough while a woman pushes it with a long stick to give it impetus enough to move along to its destination.

The spectacle would drive a modern efficiency expert to distraction, but he would reconcile himself to it when he figured out the relative cost of machinery and men.

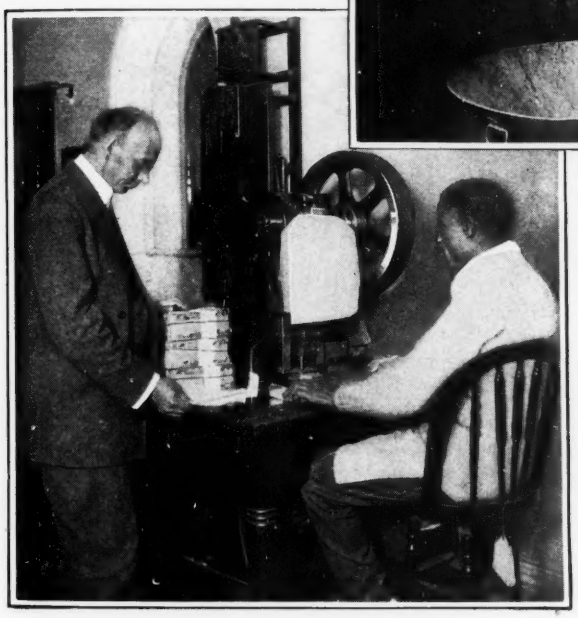
Ingenious Slide Rule for Motorists

A SLIDE rule has been devised by which a motorist can compute accurately the ratios which exist between the number of revolutions of the engine and the mileage of the car per mile; the corresponding ratio of gear reduction, etc. It can also be used to ascertain the theoretical horsepower by the knowledge of the cylinder dimensions, and the reciprocal relations between various parts of the machinery. It is intended that the device will bear the name of some automobile manufacturer and be used as an advertising novelty.

A Machine That Chews Money

FIVE million dollars a day in worn-out paper money was destroyed by machinery in the Treasury Department, at Washington, during the last fiscal year. Two tons of this redeemed paper, amounting to over three hundred and fifty million bank notes, with a face value of more than a billion and a half dollars, passed through the macerating machinery, new money being issued to take the place of that which was destroyed.

This money, after being sent to the Treasury for redemption, is carefully counted, made into piles, first punched and then cut in half, after which a committee of treasury employees sees that it is chewed up in a machine made for the purpose. It is said that the average life of a one-dollar bill is one year.



The first step in the destruction of worn-out paper money is to bind the bills solidly and compress them into packages

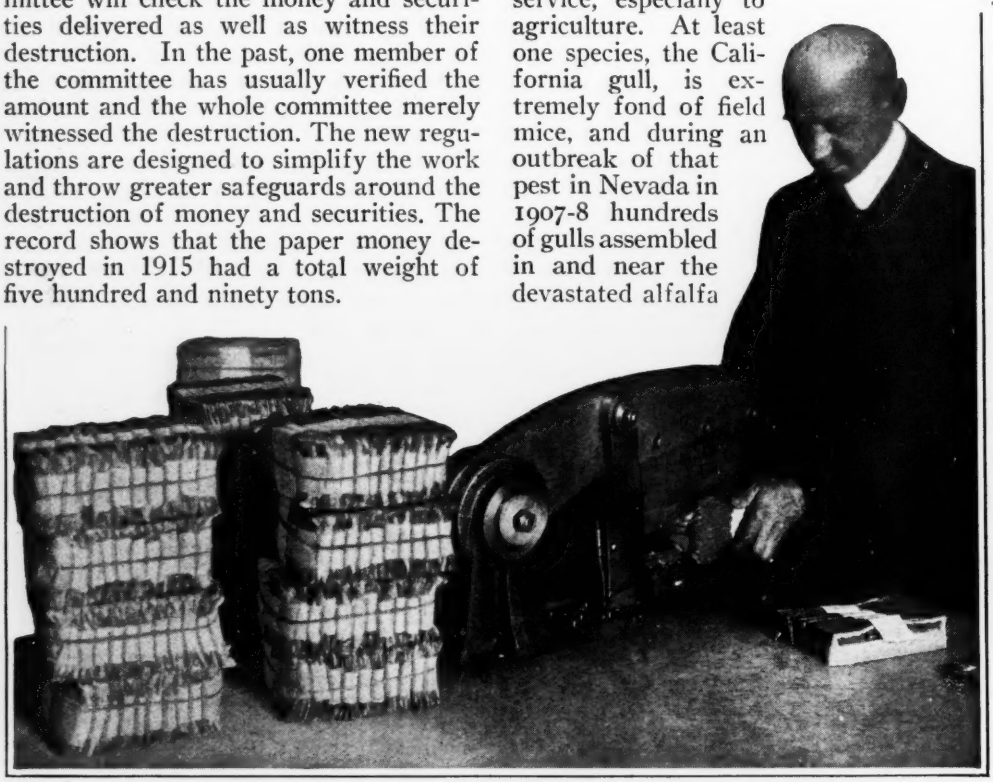
The great growth of this work since the days of the Civil War, when paper money was first issued, is indicated by comparison with figures for the fiscal year 1865, when seventy million pieces of redeemed currency were destroyed, of a face value of one hundred and forty-four million, two hundred and nineteen thousand, nine hundred and twenty dollars, which included a large amount of fractional currency.

The chief duty of these treasury employes is to see that all old paper money is thoroughly destroyed

The government first issued paper money in connection with the Civil War finances, and Secretary Chase's regulations for the destruction of notes unfit for circulation were issued as a result of an act of Congress. In Secretary Chase's time paper money and securities were destroyed by burning. Experience showed that this was not the safest plan in connection with the destruction of distinctive paper, because it is difficult to burn bundles of money, and undestroyed pieces may escape through the chimney. For this reason the act of June 23, 1874, authorized the destruction by maceration. The destruction of these once valuable bits of paper has always been witnessed by a joint committee, appointed for the purpose.

by a joint committee, appointed for the purpose.

Secretary McAdoo has recently modified the work of destroying the paper money so as to meet present conditions better. Now each member of the committee will check the money and securities delivered as well as witness their destruction. In the past, one member of the committee has usually verified the amount and the whole committee merely witnessed the destruction. The new regulations are designed to simplify the work and throw greater safeguards around the destruction of money and securities. The record shows that the paper money destroyed in 1915 had a total weight of five hundred and ninety tons.



One reason why half a paper bill is worthless. The treasury department cuts the returned bills into two pieces lengthwise as a preliminary to its total destruction

How Gulls Help the Farmer

THE term "gull" is usually associated in the popular mind only with long-winged swimmers seen along the salt water shores and in coast harbors. There are represented in the United States, however, twenty-two species or subspecies of gulls, including the gull-like birds known as skuas and jaegers. Of these some are true inland birds, frequenting prairies, marshes, and inland lakes. Flocks of gulls on the waters of our harbors or following the wake of vessels are a familiar sight, but not every observer of the graceful motions of the bird is aware of the fact that gulls are the original "white wings."

As sea scavengers they welcome as food dead fish, garbage, and offal of various sorts, and their services in cleaning up such material are not to be regarded lightly. It will, however, surprise many to learn that some of the gull family render important inland service, especially to agriculture. At least one species, the California gull, is extremely fond of field mice, and during an outbreak of that pest in Nevada in 1907-8 hundreds of gulls assembled in and near the devastated alfalfa fields and fed entirely on mice, thus lending the farmers material aid in their warfare against the pestiferous little rodents.

In Salt Lake City, is a monument surmounted by two bronze gulls, erected by the people of that city "in grateful remembrance" of the signal service rendered by these birds at a critical time in the history of the community. For three consecutive years—1848, 1849, and 1850—black crickets by millions threatened to ruin the crops upon which depended the very lives of the settlers. Large flocks of gulls came to the rescue and devoured vast numbers of the destructive insects, until the fields were entirely freed from them.

Motor Car Mows Railroad Weeds

A PRACTICAL railroad man has invented a weed cutting machine, which derives its energy from the source that runs the gasoline-driven handcars running up and down sections of every track.

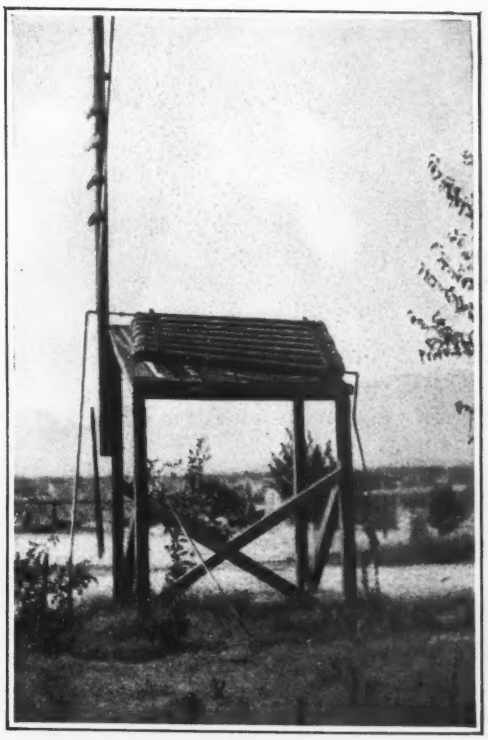
There are a number of advantages in the new weed destroyer. The cost of labor has been cut enormously. A section crew with scythes working all day can cut no more than a mile. The usual price for this work is $1.75 per man per day. Thirty cents is the cost of cutting the same amount of weeds with the motor weed cutter, which mows down heavy weeds and grass at the rate of a mile every twenty minutes, averaging twenty-five miles a day.

Cutter bars are so arranged at the sides of the car that they can be raised by the operator in case of obstruction on the roadbed, but when down follow the angle of the ground perfectly. The blades can be stopped or started without raising, and the little gasoline driven traveler can pull itself along whether it is on or off the track.

Traveling at the rate of three miles per hour the gasoline scythes cut a swath six feet wide on each side of the track. If the lay of the ground varies on either side of the track, as is often the case, the blades can be handled by the operator to conform to this condition.

A regular crew of three men is required, and this number accomplishes the work that formerly required one hundred men.

Three men on this motor hand-car can mow as many weeds in a day as a hundred men working in the old way



With this simple device the sun's rays are utilized to heat water

Using the Sun's Heat to Heat Water

IN the Southwest, where the sun at noontime is extremely warm, all sorts of heaters have been invented to catch and utilize the sun's rays. In the case illustrated here, the coils of pipe, which are connected with the water system in the house, are arranged on a framework in a position where they are exposed to the sun during the hottest part of the day, and so great is the heat that the water becomes warm in a short time.

Still Enough Coal

ACCORDING to the International Geological Congress, there is coal enough yet unmined to last the world nearly six thousand years at the present rate of consumption. There is a reserve of unmined coal estimated at 7,398,561,000,000 tons, of which two-thirds are in the eastern United States.

Hospital Work on the Firing Line

UNITED STATES field hospitals, the least understood divisional units in the United States army, have been newly equipped in order that they may be more mobile during battle. The field hospital service of our army, as it is constituted today, is one of the best in the world.

Contrary to popular opinion, field hospital men are trained soldiers. They do their most important work under fire, and in war, their dead and wounded rank next to infantry in number. While the officers of field hospitals are surgeons and while the privates have been instructed thoroughly in first aid work, the real duty of the field hospital men during battle is to keep the front clear of savable wounded men. The field hospital problem is one of rapid transportation. During the past four years, since the system conceived by Tripler during the Civil War has been put into operation, every scheme to make it possible for field hospital officers and men to work swiftly has been resorted to.

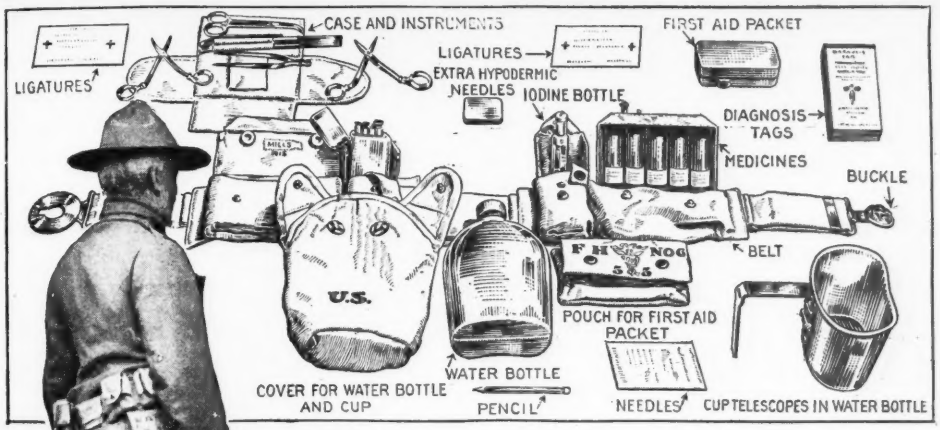
Officers and men of the hospitals are walking dispensaries. The officers carry surgical instruments, extra hypodermic needles, needles, ligatures, medicines, first aid packets, large iodine bottles, large water bottles and cups, diagnosis tags. During battle the officers can spend little or no time in dressing wounds or in "cooling the fevered brows" of fallen soldiers. Their time is occupied in directing the bearer-men, or littermen, who carry wounded soldiers to the field hospitals just outside the line of fire. While doing this transportation work, the stretcher bearers are really more under fire than the fighting soldiers.

The new equipment furnished the field hospital men is as compact and as light as possible. Each man carries a meat can, a bacon bag, knife, fork and spoon, a water bottle, ten first aid packets, iodine swabs, five plain gauze bandages, safety pins and adhesive plaster, corrosive sublimate gauze, diagnosis tags and pencil, a large water bottle, instrument cases, forceps, scissors, and a hatchet. The enlisted men are thoroughly trained in the uses of the instruments they carry. When they have time, they administer first aid treatment to wounded men, but if they are pressed for time in the heat of battle, they devote all their energy to getting savable wounded men to a point where they may be in comparative safety while awaiting surgical treatment.

The men are taught that their work is to protect Uncle Sam's fighting material. They are not permitted to spend any time at the front with fatally wounded men, but to strain every nerve in saving wounded men who can be patched up to fight again. No nurses are permitted at the front. They are at the base hospitals, usually out of range of the enemy's guns. It is possible to take down and pack up on mule-drawn ambulances the entire camp equipment of a field hospital in two hours.

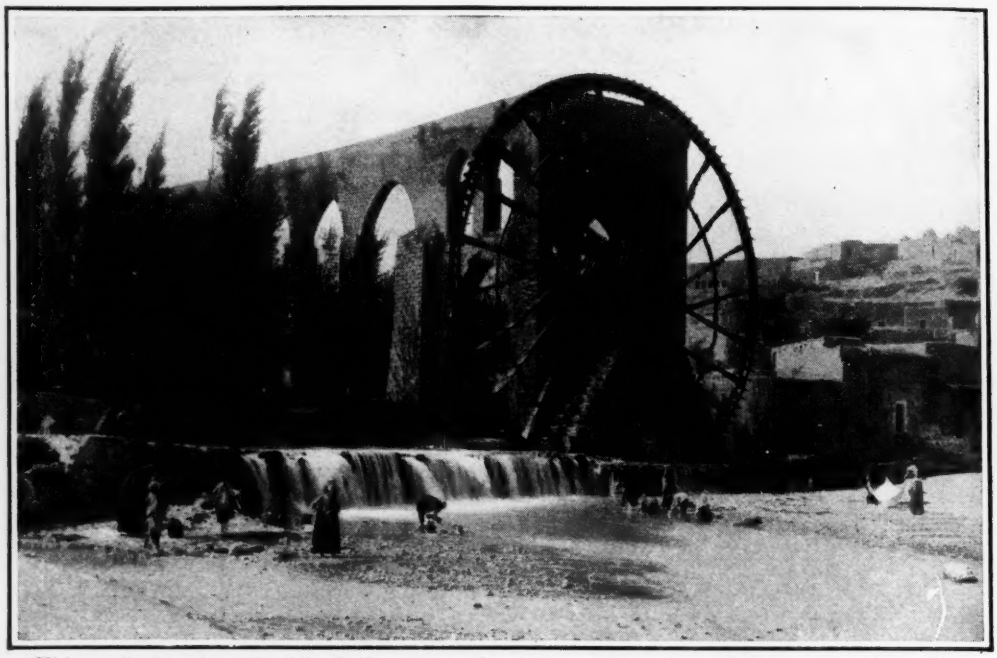
Ordinarily, that is, in time of peace, the camp tentage of a field hospital is as follows: five small pyramidal tents for officers, nine large pyramidal tents for soldiers, five tropical hospital tents for kitchen, stores, mess, dispensary and operating room, six ward tents each concontaining thirty-six beds, and tents for officers', patients', and men's latrines, with one for the men's bath. In field service the large pyramidal tents are not carried, and one thousand four hundred and ninety-eight pounds of weight are saved. No tent furniture or cots are carried.

The field hospital equipment for service weighs eight tons and is transported on eight four-mule wagons, which are used for ambulances. The army is now experimenting with motor cars to supplant the mule-drawn ambulances, since a similar equipment serving with the American Ambulance on the French front has proved remarkably successful. Fifteen horses—seven for the officers, two for the major, and eight for enlisted men—go with the field hospital equipment. The organization carries three days' rations, three pounds to a man, or eight hundred and ten pounds, and one thousand three hundred and sixty-eight pounds of forage for the animals.



A Walking Dispensary

The hospital corps of the United States army is learning much from the developments of the war in Europe. It is likely that the old ambulance mule, among other things, will at last give way to the swift light automobile



This ancient water wheel in Syria pumps the river up into the aqueduct at its top. Thus a wide territory is watered by other aqueducts and canals

Immense Water Wheels Which Lift Their Own Water.

HAMA, in Northern Syria, referred to in the Old Testament as Hamath the Great, is justly famous for its huge water wheels. The city lies some one hundred and ten miles northeast of Damascus on the River Orontes, and upon its banks are four huge water wheels used for drawing water for irrigating purposes and also for supplying the town. The wheels are driven by the flow of the river on what is known as the undershot principle; that is to say, the wheel is moved by water passing beneath it.

The largest, shown in the accoming photograph, has a diameter of seventy-five feet. Upon its outer rim is a series of buckets which raise the water and deposit it in the aqueduct at the top. Like its companions, the wheel is built of mahogany, with an axle of iron. The creaking of the wheels is incessant, day and night, year in and year out, for they never stop.

It is interesting to note that wheels built on this same principle are in actual use in this country, in one of the fertile valleys of California, as described in the December issue of the POPULAR SCIENCE MONTHLY.

A Golf-Tee Fertilizer

AMONG the hundreds of patents issued every week occasionally one stands out above all others as being entertainingly original and ingenious. Such a patent is one issued recently for a golf tee. It is intended that the tee shall be shattered to tiny fragments when the ball is struck, and to act as a fertilizer after having been broken.

The tee is manufactured in a conical shape with a cupped top, into which the ball fits. It is made of green gelatine, so that, contrary to the condition which exists in the paper and rubber tees, the golfer can keep his eye on the ball without the usual distraction. When the club strikes the ball, the gelatine tee is simultaneously struck and shattered to a veritable powder. These small green fragments scatter on the grass and are dissolved at the earliest rain.

As gelatine is an excellent fertilizer, the shattered tee serves a very useful secondary purpose.

Why There are Defective Babies and Monsters

A cretin, aged forty-two

It is not our purpose in this article to comment upon the ethical right of a physician to permit a defective infant to die. What can science do to prevent Bollinger babies from being defectives? Why are defectives born from apparently normal and healthy parents? The subject has been studied by many scientists and their results are here summarized.—Editor.

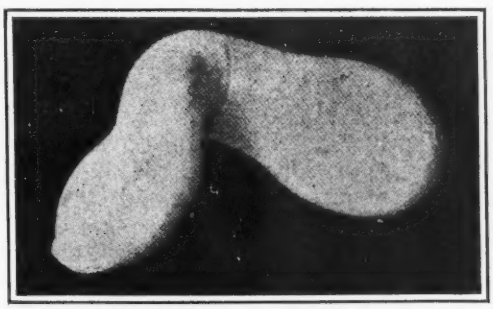
A defective who is almost an idiot

BOTH in Sinbad, the sailor, of Arabian Nights' fame, and Homer's Odyssey, there are narrated, strange tales of a monster with one eye in the middle of its head, who was so gigantic and so voracious that he ate two men for breakfast and two for supper, besides emptying three bowls of wine. This creature was called Cyclops or Polyphemus. Another strange formation described in tradition as a "Winged Horse" was Pegasus, the steed of the Muses, which was faster than ordinary horses, because of its wings. Unicorns or horses with spear-like horns are also mentioned in ancient histories as are other human, animal, and plant pedigreed prodigies.

Side-shows, dime museums, fairs and the circus have special departments devoted to exhibitions of Jo-Jo, the Dog-Faced Boy; the Bearded Lady, Siamese Twins; two-headed calves; four-legged hens, and various animal and human monstrosities. The manner in which the odd, contorted creatures are formed, whether they are inherited, like club foot, color blindness, and webbed fingers, or are suddenly caused before birth as the little Chicago baby's deformities were traced to the prospective mother's typhoid fever, has been a much debated medical point.

Dr. E. I. Werber, of Princeton and Yale Universities, has undertaken experimentally to ring the changes on all theories, doubts and opinions by finding exact facts upon which to base the whole problem. It is now possible to attempt an explanation of the strange malformation of the little Bollinger baby born in the Chicago German-American Hospital on Friday, November 12, 1915, which created such widespread interest, because Dr. H. V. Haiselden, the German surgeon, refused to operate to save its life. The principal physical deformities in that much-discussed case were the closure of the intestinal tract, paralysis of the nerves of the right side of the face, the absence of the right ear, blindness of one eye, and malformation of the shoulders. The brain was only slightly subnormal, but the cranial nerves were absent or undeveloped.

"If he grew up he would be a hopeless cripple and would suffer from fits," said the doctor.



A twin egg monster before development

Many of the visitors at the hospital treated the baby, which lay in a little bundle in a private room, as if it were uncanny. Dr. Haiselden alone treated it like a human being. He looked into the little twisted face and patted its cheeks.

"It would be a moral wrong to let it live. It seems to me that a city which allows a Blackhand outrage a week, a thousand abortions a day, and an automobile accident every round of the clock is hardly in a position to criticize a man who holds that death is preferable to life to a defective."

Dr. John B. Murphy, former president of the American Medical Association, and physicians and professional men generally, took sides with Dr. Haiselden. But his critics were just as numerous.

Dr. Rosalie M. Ladova commented: "A life is a life and I wish Dr. Haiselden had stepped out and let someone else operate."

Can Science Prevent Defectives?

The most serious question, however, is how to prevent just such monstrosities as the unhappy Bollinger infant and to this end Dr. E. J. Werber, and independently Professor F. E. Chichester of the Zoological Department of Rutgers College, New Brunswick, New Jersey, have directed their experiments and discoveries.

Before the eggs are made fertile and begin to form the unborn baby, colt, puppy, or other animal, these investigations proved it to be possible to induce such changes in the eggs or early embryos by inoculation into the blood stream of the mother the poison of diabetes, of kidney diseases, of typhoid fever, and other poisons and waste materials, so that deformed offspring would be developed and born. With two substances, butyric acid and acetone, chemicals that are produced in the blood of those who have sugar disease and sugar

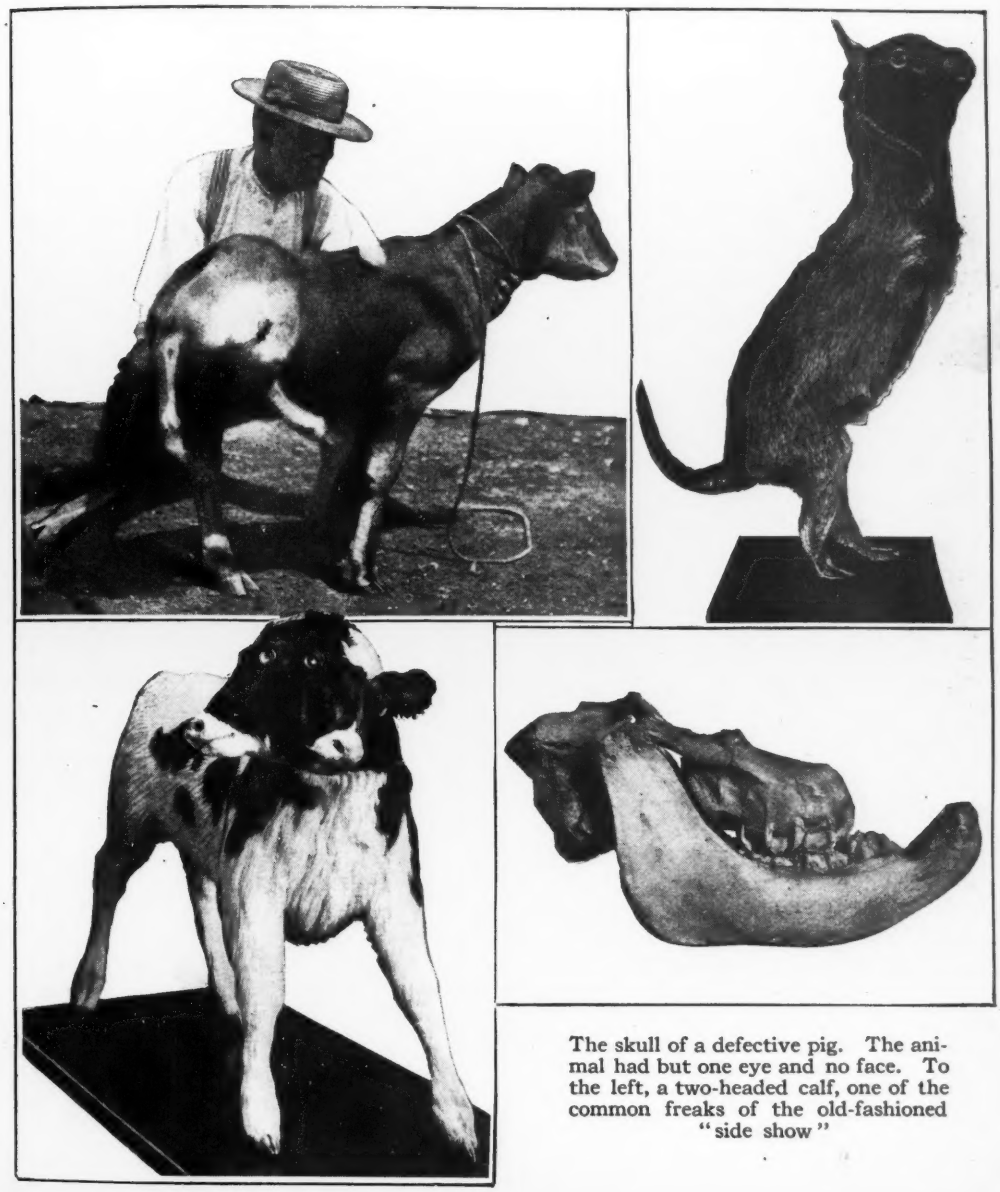
Should these children ever have been born? To the left is a cretin; beside her a type technically known as a Mongolian idiot; next comes a micro-cephalic, who is a burden to himself and to the institution in which he is confined; the last on the line is a water-brained (hydro-cephalic) girl for whom society has no use

in the flowing lymph and serum, a great variety of monsters were born in the experiments of Professor Werber.

These experiments yielded defectives and monstrosities, similar to the Bollinger baby, to mythical Cyclops, to Siamese twins, and to creatures without legs, without necks, minus eyes, with absent ear or entire faces, with open spinals, open brains, with tails and without tails, armless, and even clubbed feet. Hydrocephalus, in other words waterlogged head, where the upper part of the head is so elongated as to resemble an Atlas, was produced by alcohol and other poisons in many embryos. In many, parts of the organs were lost, shrunken or undeveloped. Sometimes only half of the body developed. Some eggs were found to have one eye de-

A calf which started to grow a second body

A puppy born without fore legs. It lived six weeks



The skull of a defective pig. The animal had but one eye and no face. To the left, a two-headed calf, one of the common freaks of the old-fashioned "side show"

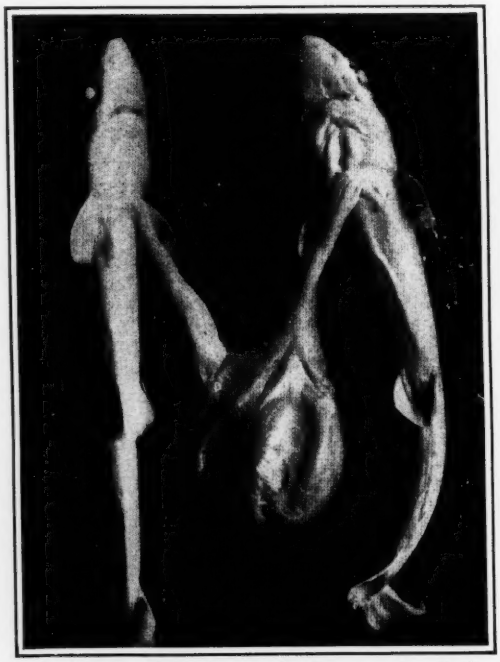
veloped so large as to crowd out the rest of the body.

The various acids, chemicals, and bacterial poisons used seem to act upon the multiplied egg, after it has subdivided many times into a compound egg. These are fragments broken off by the poisons in the blood of the mother, and the particular divisions which are poisoned cause the malformations and freaks.

Making Hens Lay Double Eggs

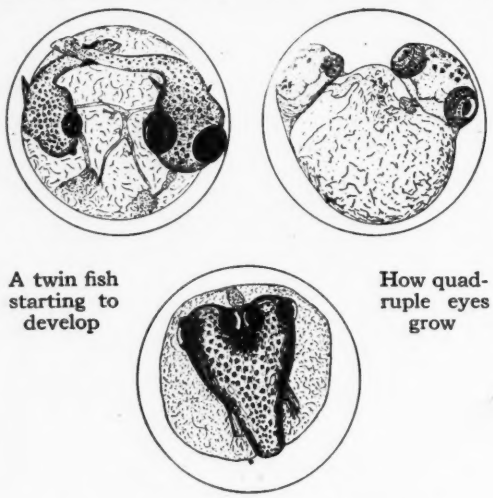
Examples of eggs within eggs have been attributed to the serpentine movements of the flexible canal through which they pass. Hens frequently lay several double eggs in succession. Fere, a distinguished investigator, claims that he succeeded in producing double eggs in a hen which normally laid single eggs, simply by drugging her with belladonna. Glaser, another biologist of note, has described the ovary of a hen which habitually laid double eggs and concludes that fusion is the explanation of some double eggs.

The one which Professor Chichester wishes to record is a "gourd-shaped" egg. Professor Hargitt studied one, which was not preserved carefully, and on account of evaporation, the condition was such that he could not be certain of the presence of yolk in the smaller end. He assumed that the egg was comprised of about normal parts in the larger end, and that the smaller consisted of only albumen, "its yellowish tint having resulted from the evaporating process which had taken place."



A twin dog-fish, the result of some chemical effect upon the egg

Many cases of twins and double monsters in fish have been recorded but no case of apparent modification of structure by chemical means in one of the twin fish mentioned. Dr. Chichester fertilized the eggs from several female Funduli by the sperm of one male and at the proper stage, he added a dilute solution of ether in plain sea-water. Many of the eggs died. Two days later the water was changed for fresh sea-water and a few of the dead eggs were removed. Three days from the beginning of the experiment the dead eggs were picked out, and the remaining few were placed in fresh sea-water. The living eggs numbered two hundred and fifteen, and the uncounted dead eggs about six hundred. At the end of six days' time the normal embryos were separated from the abnormal.



A twin fish starting to develop

How quadruple eyes grow

A double head in process of formation

TADPOLE MONSTERS

In the first lot

there were a pair of cyclops, one pair of twins and one hundred and ten normal. In the second lot there were nine typical cyclops and seventy-eight normal. The twin Funduli were most closely observed and were killed and preserved on the sixteenth day only because it was evident that they were about to die. The cyclops was the smaller of the two; the eye on the right side was apparently lacking.

One-Eyed Animals and Men

Dr. Chichester also describes three instances of Cyclops in mammals, one in a rat, and the third in a man.

The man had an hour glass eye in the center of his forehead. The rat had no external or internal indications of an eye; the pig had no eye-ball nor lens, but had three lids, the two upper ones being fused almost completely. Neither the pig nor the rat had a proboscis.

Obviously, monsters and freaks are now in a fair way to be explained without cursing nature for a visitation, which is experimentally traceable to human ignorance, accidents, disasters, and the circumstances that interfere with the natural gravitation of living things toward an even keel, a symmetrical development and the stability of health and a balanced figure.

Maude, the Motor Mule, on Our Cover

"MAUDE, the Motor Mule," whose portrait appears on this month's cover, is an automobile which has been performing the latest dances upon various racetracks over the country. Before the racers commence their whirlwind circling of the speedways, the band plays a tango or a one-step, and "Maude" appears upon the track, rearing upon two wheels and cavorting to the tempo of the music.

A photograph and a brief article were reproduced in the December POPULAR SCIENCE MONTHLY, but a few additional details of "Maude's" way of working will be interesting here. The car was built especially for exhibition purposes. Running beneath the body is a small track upon which moves a heavy weight. Another weight is fixed on the overhang behind the rear axle. When the driver, Roy Repp, pulls a lever, the heavy weight beneath the car moves forward or back as desired, the center of gravity is upset, and the car, suddenly stopped or slowed down, rears up on its hind wheels. The counterweights are so delicate that the car may be run while balancing upon the rear wheels, as shown on the cover.

Each of the rear wheels is fitted with a separate brake. When one of these brakes is engaged the wheel is locked, and the differential gear drives the opposite wheel alone, causing the car to swing. By means of these independent brakes the car may be made to wheel and dance in time to the music.

Six hundred pounds of almost pure silver

Nature's Horde of Solid Silver.

RECENT development at some of the mines of the Cobalt district of Ontario, Canada, has resulted in the production of more of the wonderfully rich silver ores for which the camp was famous during the days of its first working. At the Temiskaming mine there has been found some rock which makes a special record for high value.

The six hundred pound slab shown assays about ten thousand ounces of silver per ton, being therefore about one-third pure silver. There is no gold in the ore, that being one of the general peculiarities of the ores of the Cobalt district.

A Real Sultan's Strange Body-Guard

OF Eastern monarchs none retain such a strange and picturesque bodyguard as the Sultan of Dyokja, one of Java's few remaining native rulers. Surrounded by hordes of strangely uniformed retainers, consisting of soldiers, musicians, singers, dancers, bearers of the royal fan and umbrella, pipe, and betel-box, his court presents an extraordinary spectacle, recalling a comic opera on a colossal scale.

The time to visit this court is during one of the many native festivals. Then one may witness a sight which for Oriental pomp and grandeur and startling effect has certainly no equal. On that occasion the troops appear in the weirdest of costumes. There are uniforms of every shade and color—black, white, blue, pink, and green—uniforms made up of several colors, striped uniforms, and uniforms enriched with gold lace and other trimmings. Some take the form of tightly-

The general of the Sultan of Dyokja's army

The sultan of Dyokja, in Java, maintains a court which must be the envy of the comic opera librettists. The uniforms are all queer, and the etiquette is individual and very Javanese, especially in minor matters of oriental deportment

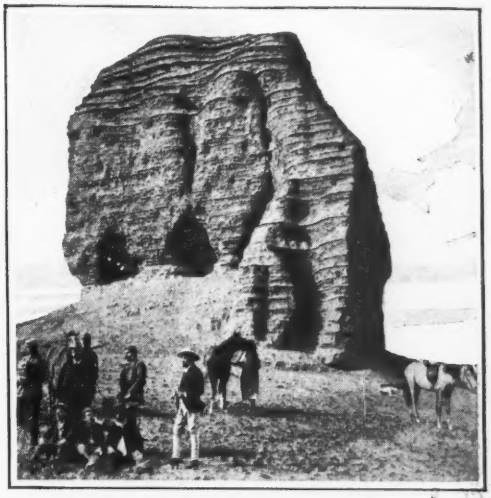
fitting tunics, others possess a distinct Western cut, while others again wear loose-fitting gowns, reminding one of a lady's tea gown.

The headgear is equally as varied, that of the Sultan's personal bodyguard consisting of a highly embellished pyramid shaped hat with a wide brim in front and two laps that fall down over the ears. So far as the weapons are concerned, they are about as varied and wonderful as the uniforms. Some men are armed with long pikes, others with lances, still others with old-fashioned, long-barreled muskets bearing ludicrously long bayonets.

Was This the Tower of Babel?

IT is doubtful if there is any place in the world so rich in ancient remains as the valley of the Euphrates, in Mesopotamia. The result is that to archaeologists and scholars the place is a veritable "Tom Tiddler's ground," and new "finds" are constantly being reported. When it is remembered that tradition places the site of the Garden of Eden here, while amongst its many ruins are those of ancient Babylon, the promising nature of the valley to the scientific excavator becomes apparent.

It is near the ruins of Babylon that we find what many scholars believe to be the remains of the Tower of Babel—an immense cube of brick work, called by the natives Birs Mimrud. Recent exhaustive examination of the strange pile and its site has revealed the fact that the tower which once stood here consisted of seven stages of brick work on an earthen platform, each stage being of a different color. The tower boasted of a base measurement of nearly six hundred square feet, and rose to an unknown height. Even to-day the ruins rise some hundred and sixty feet above the level of the surrounding plain.



A lonely pile, worn by ages of weather is the world's only claimant to the honor of being the Tower of Babel

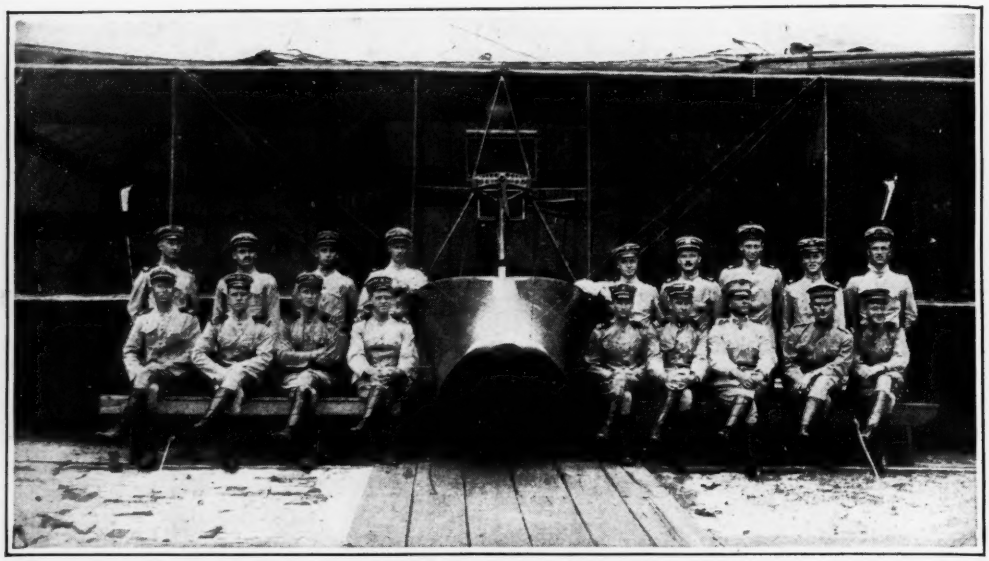
Here is one reason why walnut furniture is likely to be popular and expensive before long. This pile of American walnut logs is waiting to be cut up into gunstocks for the soldiers of Europe

Piles of Walnut Logs for Gun Stocks

THIS pile of logs represents about one-fourth of the material needed to fill a large war order received by an Iowa sawyer. His mill has a capacity of one million gun stocks a year. These walnut logs are valued at about sixty thousand dollars, and will make two hundred and fifty thousand gun stocks. Five car loads is the daily capacity of this part of the plant. Each tree is inspected by an agent of the company before it is cut.

The Death Toll of Our Misspent Aeronautic Appropriation

By Eustace L. Adams



These officers are asking, "Which of us will be next?"

THE terrible and increasing mortality rate among our Army and Navy aviators is proportionately greater than in the flying corps of any large nation in the world in times of peace. Death after death among some of the finest officers in the Army and Navy seems to be necessary to shake the officials and people of the country into a realization of facts that have been repeatedly brought to their attention.

In the fulfillment of his duties, officer after officer has flown in antiquated and patched-up aeroplanes, knowing that the machine was unsafe and likely to collapse at any minute. These young men, splendid types of American manhood, have bravely sacrificed their lives that the United States may at last look the issue squarely in the face. Their death seems cruelly necessary to drive home the fact that the Army and Navy must be supplied with sufficient modern aeroplanes.

As this article is being written, the Army and Navy have, together, twenty machines. Of these twenty, six are in actual flying condition. The rest are out of commission, some temporarily, many permanently. We have now about fifty officer-aviators who are actually capable of flying a machine; yet Montenegro, a nation so small that we seldom hear of it, although it is at present fighting in the World War, has an aeronautical corps of fifty machines, and more than two hundred first-class aviators.

Our aeroplanes are, for the most part, hopelessly out of date. They are patched and worn. Some of them are two or three years old. Each officer should have one machine, which he—alone—should fly. If he breaks a part, he should supervise its repair, and when he takes it into the air again, he should know its condition. As it is, several officers fly the same machine. Students are taught to fly in it, and the result is usually much breakage. Everyone or no one supervises the repairs. Consequently the officer who is called upon to fly never knows the exact condition of his machine.

"Another Army Aviator Killed"—how often we see that headline. It must not be supposed that these men are killed while attempting to perform circus feats, such as looping-the-loop. Despite many newspaper reports to the contrary, they are usually killed during the performance of their duty—nothing more.

What effect has all this on our aeronautical corps? The officers of the Army and Navy, detailed to aeronautical work, are dissatisfied and disappointed, but still hopeful. Some of them, who have seen too many of their brother officers and friends crash to their death, have voiced their opinions. One officer is now being court-martialled for refusing to fly machines which he knew were unsafe.

At the last session of Congress, one million dollars was appropriated for aeronautics. But, is the outlook better? Will new machines be bought, a permanent foundation built for the fleet of aeroplanes that the United States must and eventually will have? How was this needed appropriation spent? A few machines were bought, and a few more may be ordered. Although aeroplanes cost slightly more than a good automobile, we have little to show for the appropriation in the way of flying machines.

An aeronautic base *de luxe* was built at Pensacola, Florida. This station consists of a navy yard and a naval reservation, containing two villages, the civilian population of which totals one thousand and sixty-nine people. As this station is as large as some of the large navy yards in full operation throughout the country, many of the officers who had been detailed for flying service were assigned to administrative and executive duty in order to keep up and maintain this expensive plant. All this for half a dozen aeroplanes of doubtful worth and a new and costly dirigible of an antiquated type! Fine for the people of Florida, but

Landing stage at the Pensacola aero base. Many of these fine appearing machines are antiquated and unsafe, fit only for the junk-heap

expensive in the lives of many splendid young men.

What is the remedy for this shocking condition? During the present session of Congress there must be an appropriation which will insure the purchase of a great number of new machines. When we have at least five hundred machines as a start in the right direction, then, and not until then, will the Pensacola Aeronautical Station be of real benefit and be worth the money that has been spent on it.

With the requisite number of efficient aeroplanes, and money enough to maintain flying schools, the aviators of our Army and Navy will have to confront only the ordinary dangers incidental to flying, which they are ready and willing to face.

Photographs of the War

THE photography of the war has been, until recently, one of the great disappointments of modern journalism. In the first months of the great conflict, few pictures of any real interest filtered through the hands of the censors, but since the beginning of the second year, American photographers have managed to find their way to the fronts and have taken pictures which while inocuous in the eyes of the censor, had that striking news value which has made American journalistic enterprise the criterion of the world.

In the first rank of these photographers is Albert K. Dawson, of Brown & Dawson, Stamford, Conn., whose picture of a German 42-centimeter cell which pierced the walls of a Przemysl fort but failed to explode, is one of the most striking war photographs to reach this country. This photograph, which as published in our November issue, was mistakenly credited to Underwood and Underwood, but the credit of the achievement should go to Brown & Dawson, who copyrighted the picture.

Hearing the Stones on a River's Bed

A MICROPHONE installed in a sounding lead is used in taking soundings to determine the character of the Ohio river bed. An armored cable leads from the microphone to the trawler, terminating in a telephone receiver and dry batteries. The ship is propelled at a rate of from two to six miles an hour. When the sounding lead drags over the mud bottom, a dull groaning sound is heard in the receivers, while a stony or pebbly bottom will cause a series of sharp, staccato raps.

Brightening the Baby's Path

FRANK PEIRCE, of Edwardsville, Ill., an electrical experimenter, devised a way of lighting the path for his baby's buggy. He thought of the plan when the baby objected to riding

An electric light in the hood of his carriage brightens this baby's way at night or in the evening dusk

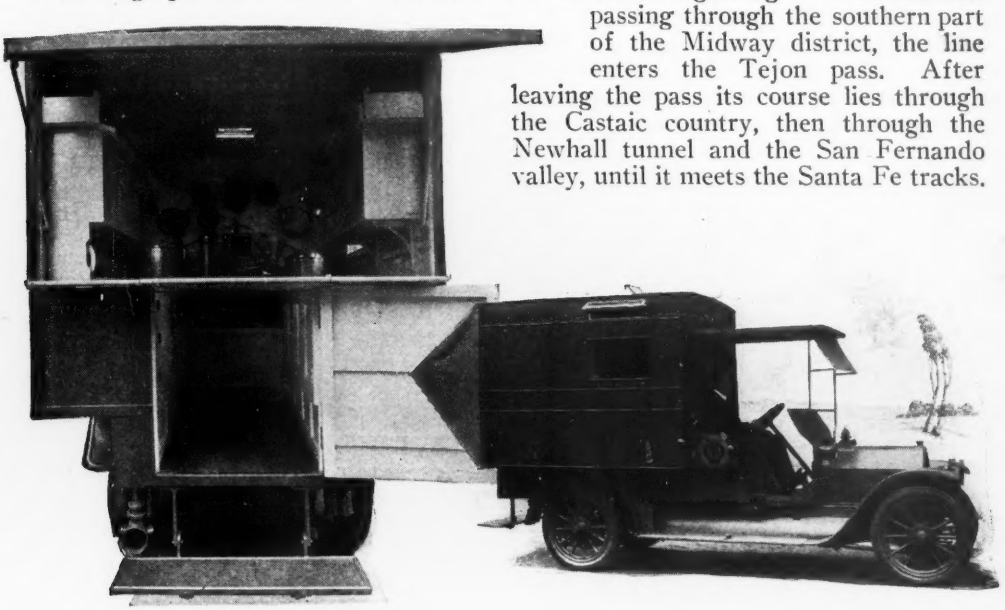
in the dark and being jolted about because of striking unseen objects. The light and reflector of a flashlamp are arranged in the top, a four-volt light being used and giving about sixty candlepower. It is connected with two dry cells in the bottom of the baby carriage, under the seat.

The light throws a ray fifteen to twenty feet ahead of the buggy. It may be easily adjusted to keep the rays from the child's eyes at all times. A plug and socket arranged in an inconspicuous place is used to light and shut off the current.

A Gasoline Field Kitchen

AMONG the useful and interesting devices of which the origin is directly traceable to the war, the automobile field kitchen in the illustrations is one that is made necessary by the swiftness with which armies in the field are transported and by the promptness with which these armies must be supplied with food. In this field kitchen the army cook raises the canopy on the rear end. Behold! A kitchen of the most compact, yet of the most complete kind, is revealed.

Four high-pressure burners furnish the heat; cleverly concealed pumps force water from the fifty-gallon tank in front of the car to the enamelled sink in the kitchen; and a variety of utensils, such as jugs, plates, meat-choppers and fish-slicers are provided for the rapid and clean preparation of food. Like most modern kitchens, too, this one boasts of ventilators, both at the sides and in the roof of the car. Indeed, it would seem as if the English firm which invented this motor-kitchen simply made a practical, miniature edition of a most approved and modern type of hotel kitchen.



The army—and the circus—field kitchen, sprawling over rods of ground, and using its coal out of a load dumped hastily in a pile, is a thing of the past. The modern equipment travels by automobile, and its stoves are all inside, fed by gas at high pressure

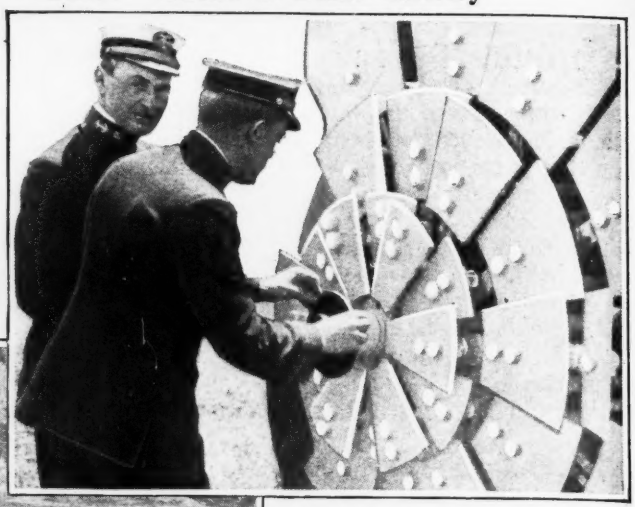
The Longest Pipe Line in America

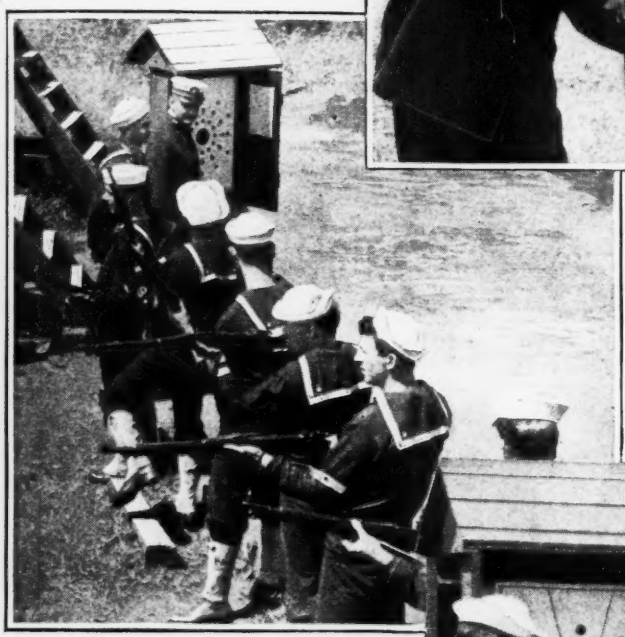
One of the greatest pipe-laying projects ever brought to a successful conclusion in the western part of this country, and possibly in this entire land, was the laying of one hundred and fifty-three miles of eight-inch steel pipe from the Midway oil fields to Vernon, California, at the expense of three million, five hundred thousand dollars. This line has a daily capacity of between twenty and thirty thousand barrels of oil and represents capital of three nations.

The actual route of the pipe line is as follows: Beginning at Pentland and passing through the southern part of the Midway district, the line enters the Tejon pass. After leaving the pass its course lies through the Castaic country, then through the Newhall tunnel and the San Fernando valley, until it meets the Santa Fe tracks. Thence it proceeds to Vernon, where there is a double topping plant capable of treating about twenty thousand barrels a day, and finally on to the sea. Along the route there are eleven high-pressure and one low-pressure pumping stations, and beside these there are three chief storage stations and two loading stations. One of the storage stations, consisting of four fifty-five thousand-barrel tanks, is at Pentland, another made up of the same number of tanks is at San Fernando, and a third, consisting of six fifty-five thousand-barrel tanks, is beside the ocean.

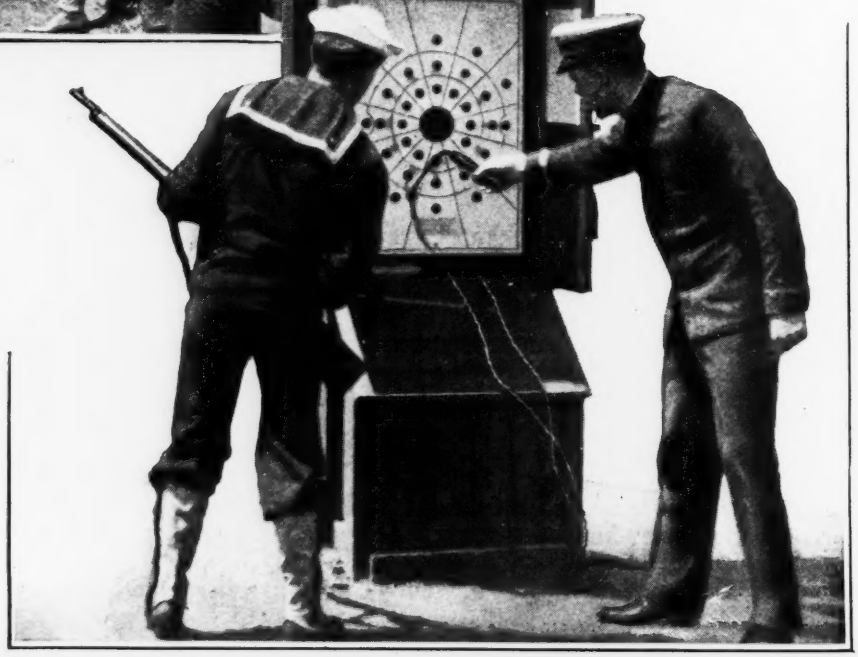
Seeing Your "Hits" Half a Mile Away

The electric target of steel is shown on the right. The bulls-eye is black and the outer circles are set behind it, in lapping arc-shaped leaves. When a shot hits, an electrical contact is closed and indicators show automatically the exact section of the target where the shot struck thus rendering it unnecessary to post men at the target to signal back the hits





As each shot is fired, the electric contact registers, and the marksman can see at once not only in what ring he struck, but whether it was to the right, left, above or below the bulls-eye, so that he can correct his range or his aim to suit. The interest which is thus aroused and the greater advantage to the marksman in knowing exactly the direction in which he was "off" make the new target exceptionally valuable in training marksmen



Saving Steps at Target Practice

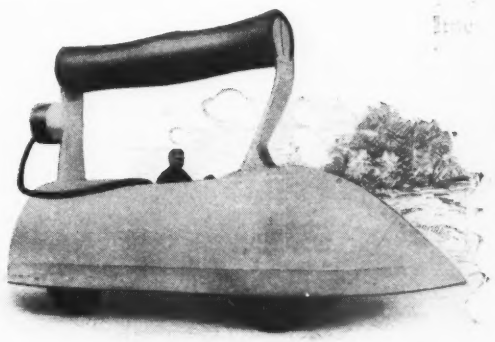
AN electrical target that signals the exact accuracy of the marksman to an indicator on the firing line has been installed on the shooting range of the United States marines at San Francisco, Calif. The method of signaling the accuracy of shots which is now employed on nearly all government ranges is not at all satisfactory, as it is difficult to convey to the man on the firing line the explicit information of the closeness of his shot to the bull's eye.

An elaborate system of flag and disc signalling is usually employed. This requires, at least on the long distance ranges, the use of field glasses. When the marksman fires a shot at a target, the "spotter" in the distant pit lowers the target and raises a signal to denote the numerical accuracy. A white disc denotes a bull's eye; a red flag, a miss, with other emblems to denote whether the bullet pierced ring No. 4, 3 or 2.

This procedure requires a large corps of men both in the pits as spotters, and on the range behind the individual marksman, as scorers. Moreover, it is confusing, and there is no satisfactory way of signalling whether the bullet which missed the bull's eye went too far to the left or right; too high, or too low.

The electrical target, as it is called, corrects a great many of these faults, although its installation cost is considerably higher. In appearance, it resembles a number of large ventilating fans superimposed one upon the other, each one smaller than the one beneath it. The bull's eye is a thick metal disc, painted black, which extends in front, of the blades. Steel plate is used in the construction. Behind the plates are electric contacts.

On the firing line is an electric indicator, which, in design, is a replica of the target. Each leaf of the target is represented by a miniature electric lamp on the indicator. When a bullet strikes one of the blades of the target, the contact made closes an electrical circuit consisting of batteries, a cable to the indicator and one of the lights on the indicator. The action is immediate, the marksman knowing instantly not only his score but the exact place on the target where the bullet struck, so that he can adjust his rifle sights to conform with wind and temperature conditions. The target and indicator are marked to resemble a clock face, following a long established practice on rifle ranges.



The enormous electric flat-iron float has taken its place as an important feature of all civic parades

An Electric Flat Iron Float.

A FLOAT that was conceded to be among the best of the one hundred and seventeen in a recent parade held by the business men of Liberty, N. Y., was a representation of a popular electric iron. It was mounted on a small runabout.

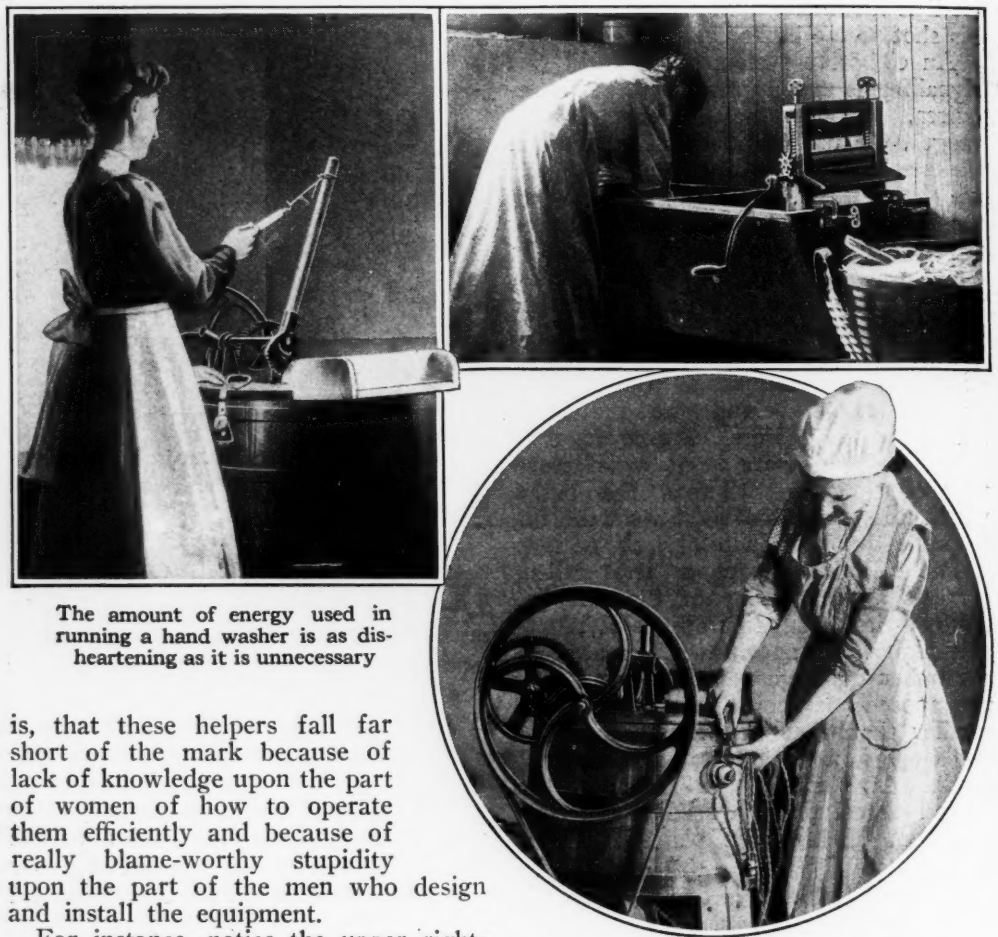
Following the business men's parade, the Firemen of Liberty held a parade and the "Iron" float was selected for participation as one of the best decorated in the previous event.

Realizing the advertising advantage, the company which made the float has had it mounted on the roof of the power house where it can be seen from all parts of the city.

The February Popular Science Monthly will be on sale Saturday, January fifteenth (West of Denver on Thursday, January twentieth).

Monday Mechanics

IN the good old days when the only way to wash clothing was to carry it to the riverside and sop it up and down and rub it upon stones, there was good reason for calling the first work day of the week blue or drab or even black. To-day, however, fortunate home laundresses have at their disposal excellent mechanical helpers. The pity of it is, that these helpers fall far short of the mark because of lack of knowledge upon the part of women of how to operate them efficiently and because of really blame-worthy stupidity upon the part of the men who design and install the equipment.



The amount of energy used in running a hand washer is as disheartening as it is unnecessary

For instance, notice the upper right-hand photograph, taken in the "convenient" laundry of an ordinary home. It is not an isolated instance. There are hundreds like it in other houses and apartment buildings. The bottoms of the set tubs are but fourteen inches above the floor. The average height for women is five feet four inches. Can she see the washboard? No; it has sunk out of sight because the tubs are too deep.

A third fault is that the tubs are poorly lighted. Number four is that the tubs are against a wall and also in a corner, accessible from too few points. The only artificial light is a single electric bulb, a sixteen candle-power carbon, hung near the ceiling in the center of a very large basement room. Then the water inlets are flush with the back of the tub, so it is not feasible to attach a

Above, the back-breaking hand tubs found in most houses. Below, the electric washer which pays for itself before it begins to wear out

hose for filling either the wash boiler or a washing machine. This means the arduous carrying of water in buckets.

The remedy is a complete change. The tubs should be out in the room instead of in a corner. There should be more window lighting and a stronger lamp located above the tubs. The laundry trays themselves should be shallower in form and their bases six or eight inches higher. There should be faucets suitable for hose attachment and set high above the rim of the tubs to be out of the way of the washing.

The laundry stove should adjoin the tubs at their left, so that the boiled clothes can be lifted directly into the rinse tub, for the washing processes are usually rounted from left to right. If a washing machine is used, however, it may be desirable to give this location to it. The best location for a washer depends upon the type of the machine and upon the style of wringer, if it be stationary or sliding or swinging.

If one uses portable tubs the bench should be slightly higher than is usual, the exact height being determined by individual experiment. Twenty-four inches is right if the tubs are for rinsing only. If one uses a washboard, twenty to twenty-two inches is preferable. Galvanized iron is better than wood because it is much lighter to handle and because wooden tubs shrink and leak if not used for a period.

When washing in the kitchen it is well to have an elastic mat to stand upon, for this lessens weariness. If a cement floored basement is used a little slatted framework of laths is good to stand upon not only to save weariness but also to keep the feet dry and warm.

If one can possibly afford it a washer is to be substituted for the back-breaking washboard. A hand power washer entails as much wearisome work as hand rubbing. Test it by attaching a spring-balance to the lever of a hand power washer filled with water and clothes. Pull on the balance instead of direct on the lever. The handle moves through an arc of twenty-eight inches and the pull is twenty pounds as the balance will show. Multiplying two and one-third feet (the arc of movement) by twenty (the pounds of pull) you get forty-six and two-thirds foot-pounds of work for every stroke of the handle. The average is thirty strokes per minute. This means fourteen hundred foot-pounds every minute. An ordinary washing is seldom less than three fillings of the machine at ten minutes per filling.

The real advantages of a washer are that scalding, sterilizing water can be used and the boiling process can be omitted, and that the application of power can be taken from weary woman's back and arms and tranferred to the stronger muscles of a man, or to mechanical power.

Some form of power washer is what every home laundress deserves. The cheapest is water power and this is available only in cities where there is unlimited water under high pressure. These do not have a motor wringer.

The woman of the farm or village can attach her hand power washer adding the proper wheel to carry a belt, to the farm gasoline or oil engine. This, too, means wringing with a wringer turned by hand. For twenty dollars to thirty-five dollars a splendid power washer is available with an attached, motor-driven wringer. The higher priced ones have also a wash bench. The power wringers are stationary, swinging or sliding.

The city woman can have that best of all servants, electricity. A one-sixth horse power motor can be attached by a belt to a hand-power washer. This is shown in a photograph on the foregoing page. Machine, motor and accessories, without wringer,cost twenty-eight dollars.

For forty-five dollars to one hundred dollars one can get excellent electric washers with power wringers included and the saving of woman-power for higher uses will justify the investment. The cost of current is very small, usually two to four cents an hour. A fifty dollar washer should last at least ten years, which is five dollars a year for depreciation. Counting interest on the investment of fifty dollars this is three dollars yearly. Current cost varies but ten cents a week, a generous allowance.

Motor Car Bodies of 1916—Good and Bad

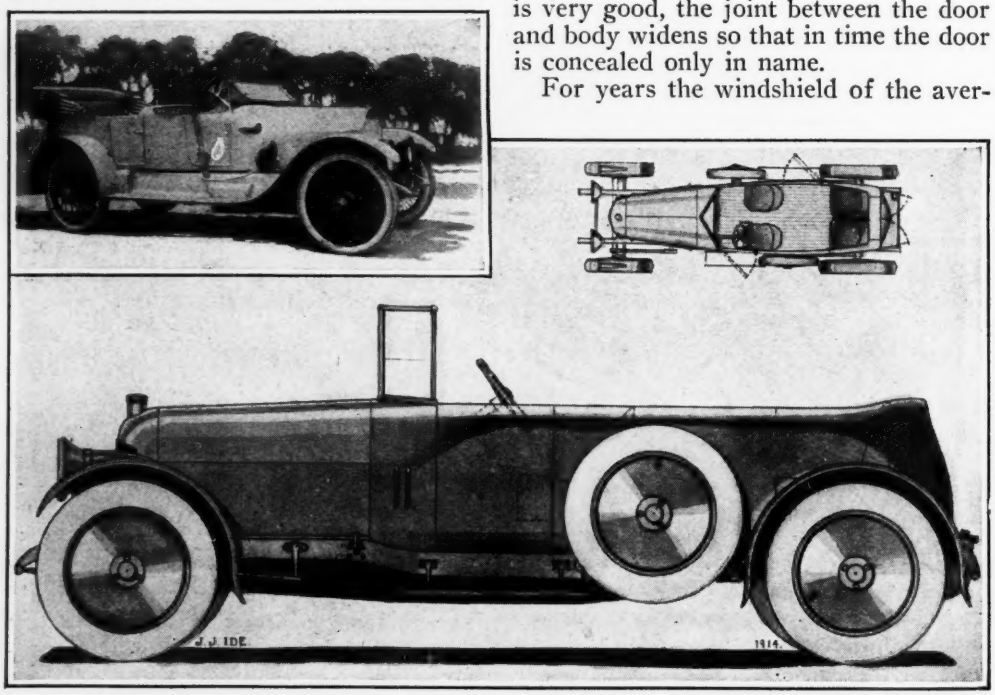
By John Jay Ide

THE average American automobile manufacturer has finally grasped some of the essentials of streamline form as far as open bodies are concerned. There are now only a few makers who cling to such features as the wide radiator, straight-sided hood and bulging cowl, low body sides affording little protection to the occupants, and upholstery protuding above the top rail. Of the cars offending in the respects mentioned several are splendid productions mechanically. One would think that the makers would be ashamed to mount coachwork of such antiquated design on their chassis.

Fortunately, these are extreme cases; the average body is a credit to the American industry. Strange to say, some of the cheaper cars are better looking than their higher priced competitors, although the palm for beauty must be awarded to a fairly expensive machine produced in Ohio. The builders of this car introduced the double cowl into stock body design last year and its effect may be seen in the number of double cowl bodies offered to the public for 1916. In fact, this type bids fair to become more popular than the body with an aisle between the front seats. In this connection it may be remarked that in December, 1912, the writer designed what is believed to be the first double cowl body mounted on an American chassis. A photograph of the car is shown on this page.

Among the features adopted on some 1916 cars is the "concealed" door, having no mouldings around it. As the hinges are not exposed, the streamline effect is heightened, but, unless the workmanship is very good, the joint between the door and body widens so that in time the door is concealed only in name.

For years the windshield of the aver-



A sporting type body designed by the author. Notice the high sides, pointed windshield, concealed top and disk wheels. In insert, above, a double cowl body designed by the writer in December, 1912. The two rear seats are divided by an arm

age American was distinguished by massive stay rods, attached to the frame and fairly successfully blocking access to the motor. Now, however, except in one or two cars it is made strong enough to stand alone. Many screens appear to have been attached to the body as an afterthought. This is the result of fitting ready made shields instead of designing them at the same time as the bodies.

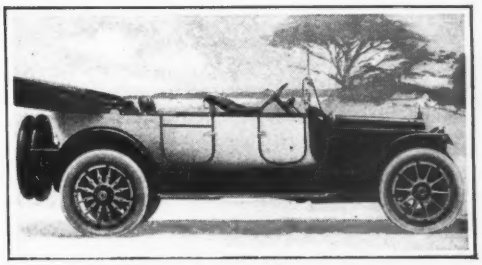
The ugly filler board at the base of the windshield is not considered as indispensable as formerly, but one well-known car continues it in the guise of a ventilator. On some machines the sides of the screens curve in at the bottom. This is not only ungraceful, but also inefficient, as the front seat occupants are not so well protected as they would be if the screen was its full width at the base. The slanting windshield was introduced last year, but has not yet been much copied.

Auxiliary seats, instead of folding against the side of the car, now often disappear into recesses behind the front seats. The double cowl lends itself well to this construction.

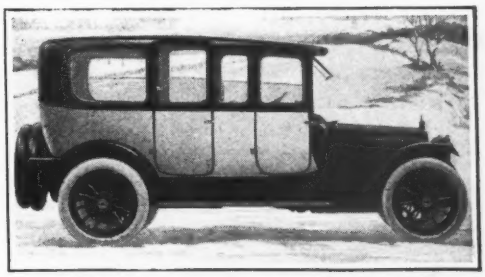
Most cars have crowned mudguards but a few are equipped with the more advanced domed type. Domed guards not only look better, but also can be moulded in one piece with the aprons, thus removing a possible source of squeaking. Many mudguards are not carried far enough down behind the rear wheels to protect the spare tires or trunk from mud. Also, the clearance between top of the wheels and the guards is often absurdly great, even when the car is fully loaded.

The detachable top for winter use was brought out last year and is now supplied by a number of makers. It gives some of the advantages of a sedan for a few hundred dollars. A bad feature is the impossibility of opening any windows except those in the doors. Very rarely does a detachable top look anything but what it is. The veriest novice would not be deceived.

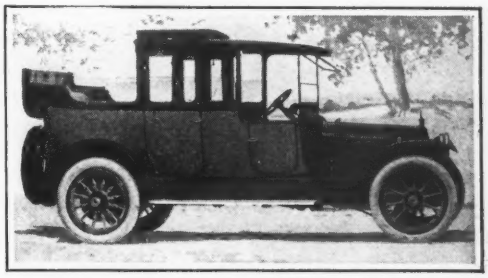
In the average American car the top of the frame is about twenty-six inches above the ground and the running board is eighteen inches. And yet the manufacturer wonders why he cannot obtain that



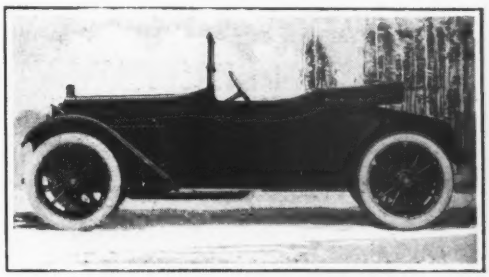
This body builds up too much towards rear. Frame and running boards are too high. Exposed upholstery and windshield stay rods are relics of the past



Height is too great. Windows when lowered clear down, are little more than half way. Curved door top breaks sweep of roof. In spite of these demerits the appearance is good

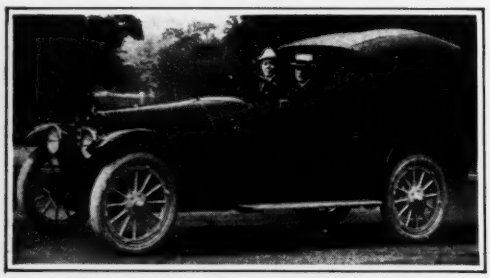


Fine, large rear side lights. Windows open only partially. Handle of front door should be concealed as it is not on level with the rear one

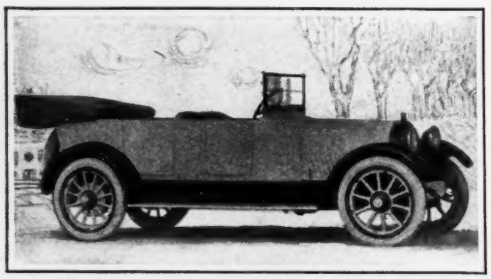


Clearance between front of rear whee and mudguard is insufficient. Rear deck terminates ungracefully. Otherwise the car is successful

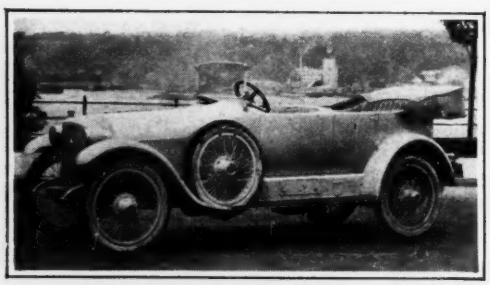
Wheelbase is too short. Front seat with its imitation of a double cowl cuts down effective opening of rear door. Back mudguards poorly designed



Radiator too low, requiring excessive taper of hood. Clearance of rear wheels and mudguards is enormous, emphasized by light colored undersides of guards



Compare mudguard clearance of this with above. Hood, with low joint and slanting vents, is the least successful part of design



If folded top were lowered, spare wheel moved forward and rear hinges concealed, it would be handsome despite ugly radiator

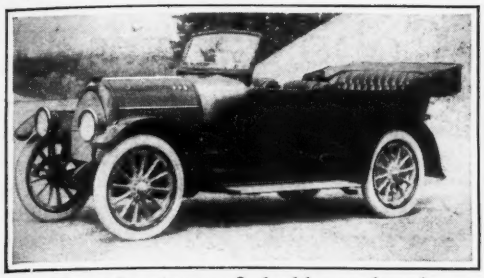
much-admired low-hung appearance, typical of the foreign car. Some day he will realize that sufficient ground clearance can be obtained with frames well under two feet high.

The unnecessary frame height is partially responsible for the ponderous appearance of many of our closed cars. Some limousines are actually between seven and eight feet high. There is no excuse for this even in a seven-passenger body where lack of foot room requires high seats.

The most glaring fault in closed body design is the impossibility of lowering the windows all the way. With a rear seat accommodating three people it is admittedly difficult to drop the rear side light completely owing to the wheel housings. English coachmakers have accomplished this by curving the window slots. Why the door lights should not drop remains a mystery.

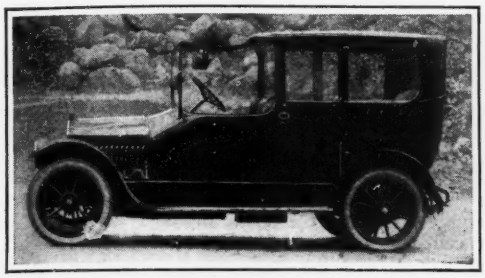
Owing to the fact that many motor car owners are dissatisfied with the appearance and comfort of stock models, there has arisen a demand for custom made bodies. The only way of obtaining collapsible bodies of the phaeton, landaulet and double cabriolet types, except on one or two chassis, is to have them made to order. If these bodies were brought out as standard models they would prove extremely popular. That is, granting that they were well made, as nothing is more exasperating than a collapsible body which rattles.

In conclusion the writer may be permitted to describe a sporting body which incorporates some novel points in design. As seen on page 98, the sides are very high, properly protecting the occupants. The plan shows the positions of doors and spare disk wheels. The seats are isolated from the body sides and back, and are adjustable fore and aft and as to inclination. The wind shield is pointed, thus harmonizing with the radiator. The top folds down into a permanent case under which is a large compartment for luggage. Domed fenders are attached to the stub-axles instead of the frame, and they follow the movement of the wheels. With this construction the fenders and wheels are concentric and the clearance between them is reduced to a minimum.

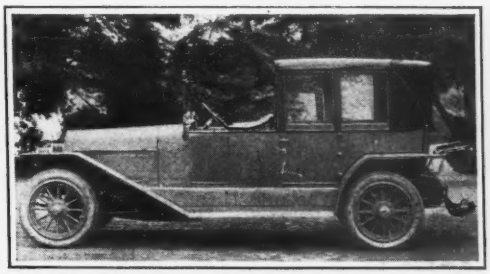


Has advantages of double cowl and aisle types. Hood tapers insufficiently, causing excessive swelling. Apron should extend up to the body

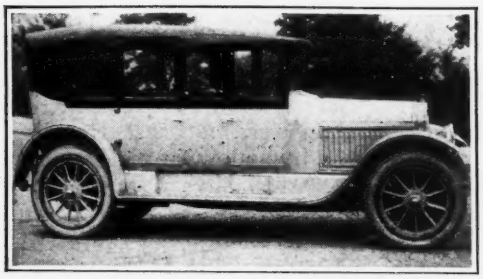
A handsome body whose appearance is not improved by mouldings on mudguards and hood. The extra seats obstruct the doors



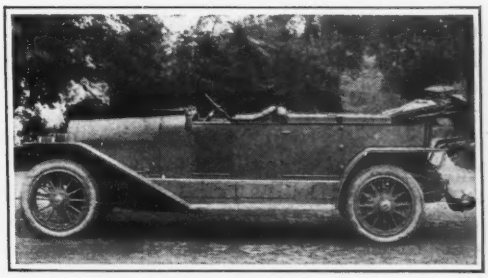
Handsome town landaulet. It can be opened rearward of the door with little overhang, as the roof over the window swings forward



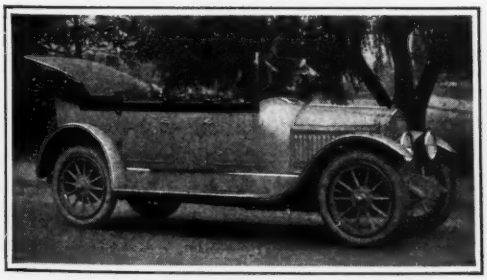
Closed position of French double phaeton landaulet. An extension top (not shown) covers the driver. Taper of hood changed from stock model (above)



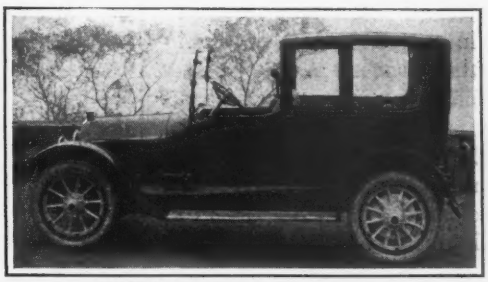
Closed position of stock "semi-touring" body. Almost the only one of its type on the market, but probably one of the important changes of the future



Open position of double phaeton landaulet. Top folds up like an accordeon and glasses in all windows drop completely. Mudguards very ungraceful

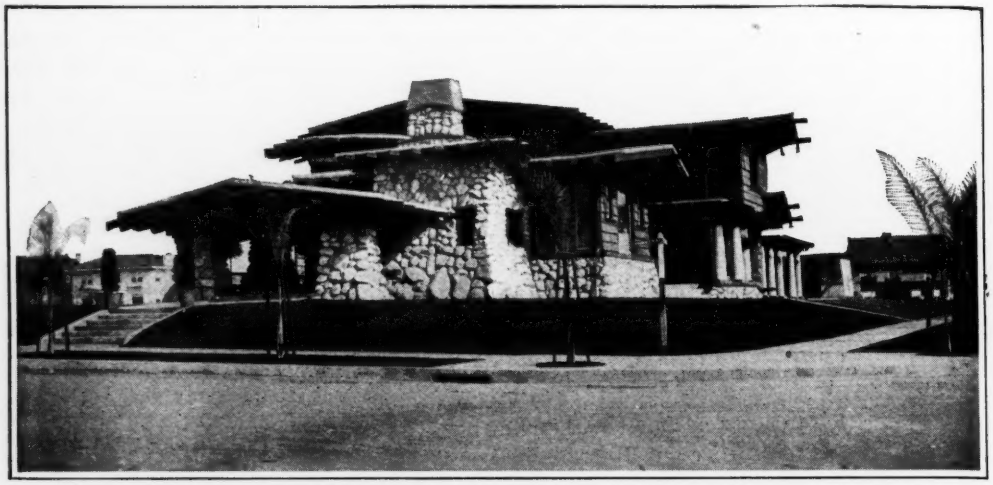


Open position of above body. The enormous mass of the top when folded down is unfortunate. Otherwise a most successful design



A well designed model. Drive protected by extension top. Windshield is not handsome. Handles of front door are concealed, as they should be

Building With Cobblestones

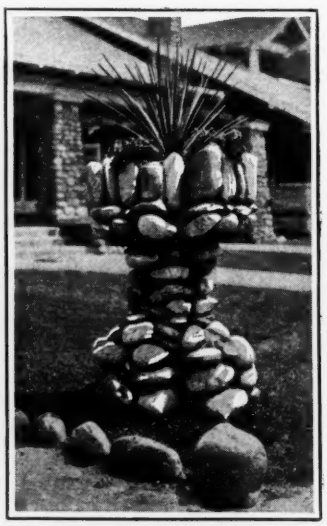


Some of the most beautiful houses in the world are built from stone carved only by the hand of Nature in the mills of the moraines through the grinding of ice-floes century after century

COBBLESTONES combined with cement are used extensively in the West for all kinds of ornamental and utilitarian construction. From ornamental urns and corner markers to fountains, bandstands, bridges and even such large structures as two-story houses, churches and even an observatory, may all be found in California, built of the cobbles that are removed in clearing.

The resulting edifices are of remarkably artistic appearance. The economy of this type of building is well shown by the fact that in the citrus belt near Los Angeles thousands of tons of cobblestones are dug up by the Hindu laborers and piled in great heaps between the groves. These cobble piles are often fifteen feet high and twenty feet broad, and extend for many rods between the cleared fields. They are literally cheaper than dirt.

It is but natural that many of the best specimens of cobble construction are found in that district. The rounded stones merely encumber the ground and most owners are willing to help pay for their removal to a building site.



Boulders and cobblestones always make attractive flower-urns

In the citrus section may be found an observatory in the grounds of Pomona College, which is a splendid bit of architecture.

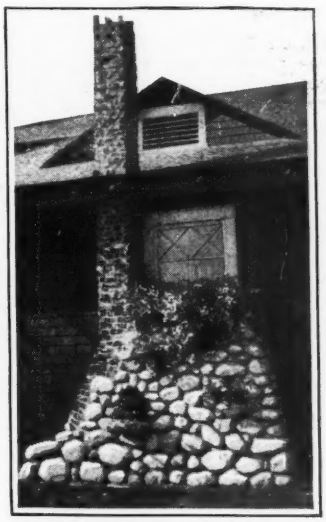
Near by is one of the most attractive homes in the West, a great rambling bungalow of field stones, which has for its main interior feature a sun parlor or glass-roofed patio. This is a most attractive detail of a charming home, with ferns and flowers growing as in a conservatory, but in a temperature suited for its use as a general living room.

In Azuza may be found a decidedly artistic cobblestone church, with only a few roughly-squared stones used in connection with the natural shaped boulders and field stones. San Diego has two large two-story houses formed of this

material, and the suggestion of permanence as well as rustic charm is made by the utilization of the big pebbles.

In the larger cities there are countless specimens of public as well as private construction formed of this rough-and-ready material. The parks contain splendid examples of the decorative possibilities of cobblestones. The bridge in Ganesha Park is far more in keeping with its surroundings of trees and shrubs than a more formal structure would be, and this applies to the bandstand in the same park and to the drinking fountain in Eastlake Park, Los Angeles.

In Glendale may be found lamp posts of cobbles. Great masses of rough stone surmounted by graceful electroliers make lighting standards that harmonize with the homes which surround them, and in some instances they are used as well for resting places at the street corners, with rustic benches and drinking fountains enclosed in the massive walls. Hollywood makes use of an unusual form of corner marker, a tall cylinder of cobbles topped by a sphere, and in this is a socket to carry flag poles for festive occasions. This is one of the most difficult types of cobble construction shown, though by no means the most artistic.

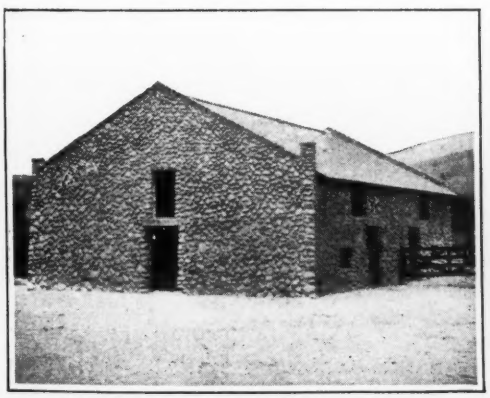


Nothing gives a finer touch to a bungalow than an outside chimney of cobblestones

Staircases and culverts are frequently built of this material, to good advantage, while chimneys, flower boxes, supports for pillars and verandas are found to be attractive when formed of rough stones and used in conjunction with frame or brick construction.

Among the strictly utilitarian buildings made of this cheap but satisfactory material may be mentioned barns, garages and even pumping stations, such as house the machinery for electrically operated irrigating apparatus in California. They are far more durable than the wood or metal so frequently used, and form an attractive detail in a well-kept country home, instead of being an eyesore.

Perhaps the most remarkable bit of cobblestone construction is an exceedingly light and graceful triple arch in the town of Huntington Park. This consists of two seven-foot arches spanning the path to the house from the street, while a third arch rests upon the other two, springing lightly from the crest of each and extending over the sidewalk. This is the pride of the owner, who has surrounded his grounds with extensive walls and flower urns of the same building material, found on his own place.



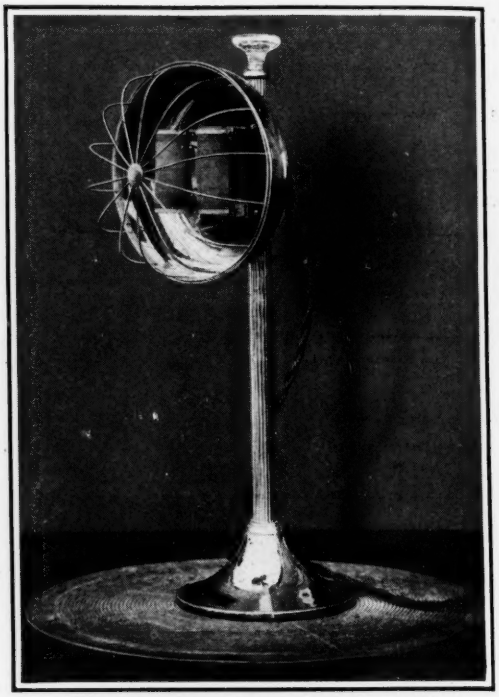
This simple but interesting barn owes most of its charm to its cobblestones

Even churches gain a new dignity when fashioned from boulders

Electric Heater Resembles Desk Telephone

AMONG the new electric heating devices being brought out is one which looks like a desk telephone. It consists of a round, transmitter-like device, about six inches in diameter, containing the usual electric coils, and with a cage in front. This is mounted on the side near the top of a standard such as is used for the electric fan.

The heater is supplied with eight feet of cord so that it may be moved around and placed either on the floor or on a table. It is made in two styles; one having two heating units, and the other having but one. The latter, of course, is less expensive to buy and uses less current. The double unit one, however, gives off sufficient heat to warm a room of considerable size. This heater can be used not only to heat a room but can be placed in such a position that it will warm the feet only.



A desk heater which radiates its comfort to the spot where it is wanted, and is still an attractive bit of furniture

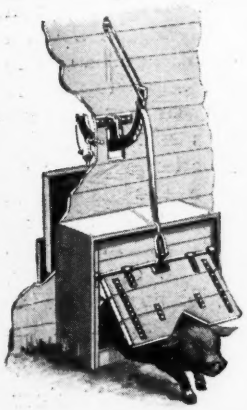
Adapting Tire Inflation to the Load

CALIPERS have been devised for measuring air pressure in automobile tires in relation to the load carried. A touring party before starting on a trip may use the new tool to establish correct pressure in the tires for the load of people and trunks, and by keeping this pressure constant tires may be greatly economized. The device is simple, small and compact, and may be used in a few seconds. The tool has a size scale and a load scale. The size of the tire at the top is measured on the size scale, and the slide moved along to the same size on the load scale. The tool is then placed over the bottom of the wheel, and if it fits easily over the tire the pressure is correct. If it does not fit, the tire is inflated or deflated to the correct point.

Blowouts can usually be traced to faulty inflation, so this tool can be expected to pay for itself.

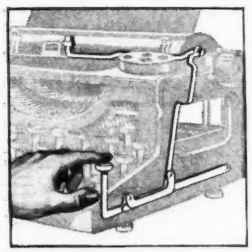
This new tool, with its corresponding tables, practically eliminates the danger of blowouts due to over-inflation with a heavy load. The driver with his scale can quickly find how wide his tires should be to ride properly, and with this scale can find how much below or above the proper pressure they are

A Hog-Pen That Counts Hogs



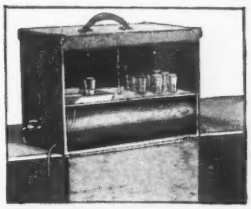
A DOOR for a hog-house that will admit only a predetermined number of animals has been invented by a Wisconsin farmer. On many stock-farms where there are a number of animal houses difficulty often arises when hogs endeavor to frequent one house instead of apportioning their numbers to the various shelters. This difficulty is overcome by the invention of a door which will admit a certain number of animals, and then no more. The door is hinged at the top. A lever communicating with a rachet above the door slips down one notch on the rachet every time the door is opened. When the last spur of the rachet is reached, the door cannot be opened.

Erasing Attachment for Typewriters



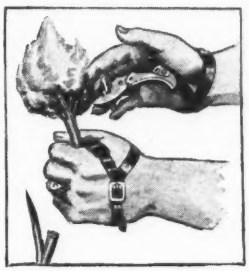
AN erasing attachment for typewriters has been brought out which does away with the time-worn practice of searching for a lost eraser when a typographical mistake is made. A key projects from the body of the typewriter, resembling the tabular key, back spacer, and similar refinements which have found their way into typewriter structure in recent years. Pressing the key operates a series of levers and arms which terminate in a rubber eraser, and rub it upwards and downwards on the paper, so that the particular error is removed. Although an erasing attachment of this kind would hardly prove suitable for business correspondence, it would probably find a wide field in newspaper or other offices where absolute neatness in typewritten matter is not so essential.

Soda Fountain in a Suitcase



A SODA fountain which can be carried with reasonable ease is the subject of a patent of interest to the men who make a living selling palatable beverages on the sidewalk. One of the ingenious features of this invention is that no one would ever suspect that the innocent appearing hand case is really a soda fountain. The case contains two separate compartments, in one of which the carbonated water is contained, and in the other, the glasses and various syrups. An inconspicuous faucet projects from the soda water tank for the purpose of replenishing the supply.

A Finger-Knife for Egyptian Corn



THERE has recently been patented a new style of knife or cutter for harvesting Egyptian, Broom, Milo Corn and similar grains. It is now in use in California.

The knife is strapped to the hand as shown in the illustration. When the stalk is grasped the fingers naturally close and off goes the head of grain. to be tossed into a wagon or bin immediately. The implement is very sharp and strong, so that it will cut practically any size stalk which will enter between the knife and guard. With an instrument on each hand a person can do twice as much work, thus saving half the cost of harvesting the crop. Before this invention appeared a cutter had to hold the stalk with one hand and cut it off with a knife in the other. It is now possible to cut the heads off the grain as fast as the hands can be opened and closed.

The blade is the part between the fingers, the dull back of the knife blade protruding rearwardly through the fingers and being held there solid by a small leather strap around the two center fingers.

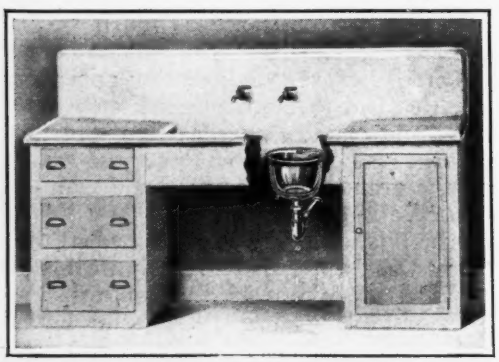
This baby's bath is soft and safe—and he can splash safely

A Tub Within a Tub for the Baby

HIS MAJESTY, THE BABY, can have a royal bath every morning in a soft little tub designed to fit inside the large tub of his elders. A seamless, waterproof fabric is supported by a rigid frame across the top of the regular bathtub. The small tub is located at the front of the frame, so that the nurse need not reach across it. The fabric goes over the bars to make a soft bumper, and it can be removed easily and laid flat for cleansing. When not in use the frame can be hung upon a hook on the bathroom wall.

Preventing the Clogging of the Sink

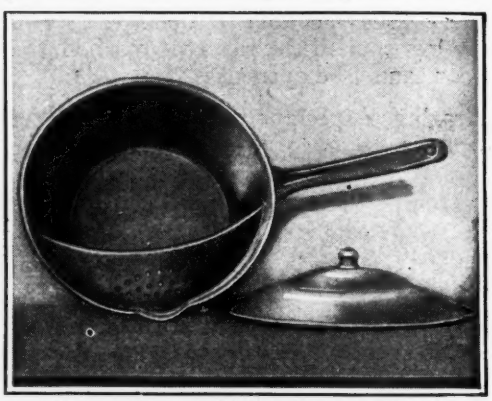
A NEW sanitary device is installed in many of the new homes and apartment houses, in Los Angeles, California. It does away with the danger of having clogged drain pipes in the kitchen. The device consists of a removable pail with a fine strainer trap in the bottom. The enamel sink is constructed so as to receive this pail, which fits snugly into place, leaving no room for bits of food to collect. The dishes are rinsed off under the faucet, and all the scraps go into this receptacle. As the strainer is finer than in the usual type of sink, all the small particles are caught in the trap and do not flow into the drain pipes. The strainer is removable so that all the grease which has been retained in the trap can be cleaned off.



This strainer is built into the sink itself

A Saucepan Which Is Also a Strainer

A SAUCEPAN which may also be used as a strainer is one of the latest additions to kitchen equipment. Pouring boiling water from a saucepan and holding the cover on to avoid losing some of the vegetables is always dangerous. The new saucepan has a strainer equipped with a rim on the pouring side of the kettle in which holes have been punched. In use, the cover is removed, the pan picked up by the handle, and the water poured out. The rim prevents the food from spilling, but allows the water to run.



No need to scald fingers in draining vegetables from this saucepan

The pan is especially useful for boiling potatoes in their jackets, since the operation can be accomplished so quickly that when the cover is put back, enough steam is retained to burst the jackets. The main qualification of the new saucepan, is that the housewife is less likely to burn her hands than with the ordinary utensil.

A Tea Kettle Which Does Not Burn

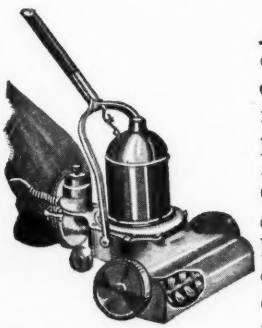
A SAFETY-first tea kettle has only recently been placed on the market. It may be filled under a water faucet without the danger of burning the hand with steam. The device, which makes the kettle safe to handle, is a separate filling top, in front of the usual top, and outside the handle.

This separate top is manipulated by a pressure of the thumb on a small handle. The escaping steam cannot burn the hand, since it rises a couple of inches forward of the handhold.

A Garbage Can Which Cannot Spill

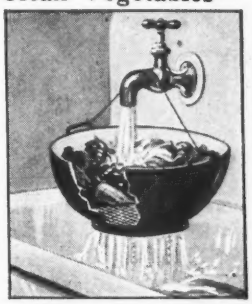
GARBAGE cans with covers that lock on are essential, especially to women in the country, where there are prowling dogs. The one shown has a handle which presses tightly against an arch of wire on the lid, holding the cover securely on the bucket. It can be removed by jerking the handle over one of the humps in the arch. The same principle is applicable to pots and pans for kitchen use.

Combining a Brush and a Suction Pump in a Cleaner



A ROTARY carpet sweeper and suction cleaner combined is the subject of a patent recently issued to a man in Ohio. Heretofore, carpet cleaners have been of one of two types, the one employing the rotary brush and the other relying upon an inrush of air. This latter type is the well-known modern vacuum cleaner. In the new invention the revolving brush serves to loosen threads and other clinging objects from the carpet, while the vacuum attachment removes fine dust.

Simple Way to Clean Vegetables

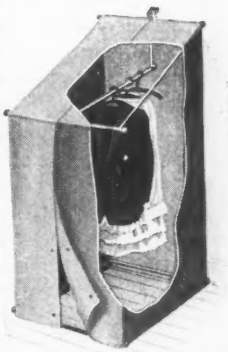


IT is no longer necessary to waste much time in thoroughly washing vegetables. One of the simplest yet most effective devices for cleansing them quickly is illustrated herewith.

It consists merely of a pan the bottom of which is covered with a fine wire screen. The pan is suspended from a faucet over the sink. When the water is turned on, the dirt is dissolved and drained off.

The screen-bottomed pan is much more effective than a colander for this use, as the drainage is complete and immediate.

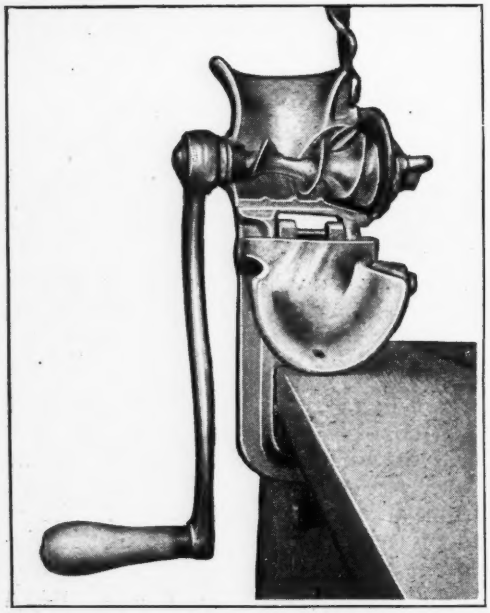
A Collapsible Wardrobe



A PORTABLE wardrobe for protecting garments consists of a canvas covering suspended from a folding frame. A rod extends from front to back of the frame, near the top, and from this rod clothes hangers are suspended. A wardrobe of this type is desirable in places where a permanent clothes closet is not necessary.

Bottle Corks Made From Blood.

A NEW process for making the thin cork layers which are used to seal hermetically bottles having metal tops involves the use of blood. Granules of cork are bleached and compressed in turpentine, glycerine and blood, from which the white proteid has been removed. A low heat is first used. After it has dried, the temperature is raised to 240 degrees for one hour. The mass is then pressed in the discs.



Here is a meat chopper which opens on the side and has no secret corners for germs to hide in

A Meat Chopper Which Opens Like a Book

A NEW meat grinder which is easy to clean, opens like a book, leaving no hidden recesses. One of the chief faults of the old grinders was the difficulty of cleaning them thoroughly. The new one will be a great labor-saver for that reason.

The hopper is split in two, and though when closed resembles the ordinary ones, one side when unlocked drops down, leaving the entire hopper and mechanism exposed. The lock is a lever which, when raised, allows the side of the hopper to drop. The hinge at the bottom of the food receptacle is merely a steel rod passing through holes in two projections, which turn on the rod, allowing one side of the chopper to drop.

A Spanish Lesson in Aeronautics

THE Spanish Government has established an aviation school which well serves as a model for a similar institution in this country.

On the first of October the new Spanish aerodrome about five miles outside the city limits of Madrid was opened to the public. The Spanish Government assists those receiving instruction. The number of pilots instructed at the same time is twelve, who have to pay ninety-seven dollars and fifty cents to cover cost of fuel, breakage, etc. The fee for mechanicians is but forty-eight cents.

The cost of these lessons ought to be well above ours, since most of the machines were brought from this country, and the price of gasoline is more than double what we have to pay. Yet the cost of learning to fly in this country is from three hundred and fifty dollars to five hundred dollars.

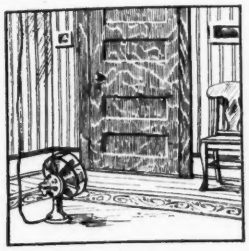
Ice Cannot Fall Out of This Water Pitcher

AN ice-water pitcher, resembling a coffee-pot, has a top of glass which locks on securely so that water may be poured from it without causing the ice to fall into the tumbler. The top resembles that of certain teapots, for it has little projections which fit into hollows made for them. Hence, when the top is slightly turned the projections are under the ledge at the top of the pitcher, thus locking it fast. Such annoyances as are caused by pieces of ice falling out, flooding the tablecloth with water, and filling the tumbler with ice instead of water, are impossible with the new pitcher. In addition the lid is a protection against flies in warm weather. Being made of annealed glass, the pitcher will withstand any degree of heat.

The ice cannot fall into the glass when water is poured from the pitcher

Winter Uses for the Electric Fan

HAVE you ever thought of the various uses to which the electric fan in your home can be placed other than lowering the temperature and making it comfortable in the room when the thermometer is high outside? How really indispensable it is in innumerable ways, and how much it does in preserving health in the home by keeping the rooms cool and fresh?



Drying Paint

If you have just finished painting a door, wall or window sides, let your electric fan run in the room for two or three hours, and the paint will not only dry faster, but it will be free from the dust that often sticks to wet paint. If you have varnished your floor, place your electric fan so that the air it stirs up will have free access to the wet varnish. Your floor will look brighter than if permitted to dry in the usual way.

Keeping Milk Cool

If you have used enamel paint to give your bathtub a new and bright appearance, use your fan to dry the enamel; the surface will be much smoother and of greater firmness.

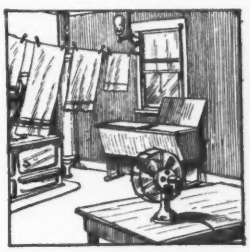
It is a wise plan from the sanitary viewpoint to allow your electric fan to run for at least a quarter of an hour in the bed chamber before you retire. It cools and freshens the air, making the chamber both more comfortable and healthful for the night.

Before you work in your office, library or den, let your fan run a half hour. You will not be liable to the slight headache, so often felt after a brief time at work in a place where the air is close.

Dust cannot accumulate where there is a free circulation of air, especially fresh air, and it is very noticeable that a room in which an electric fan is allowed to run seldom has dust. Since dust breeds germs, the prevention of dust likewise prevents germs.

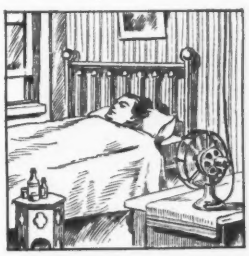
The electric fan keeps the temperature of drinkables down. Open a cupboard in which there are milk, wine, or beverages of any kind and allow your electric fan to run immediately in front of it, so that its cooling blast will strike the bottles. The temperature drops rapidly.

The electric fan has other offices in the home. The wise housekeeper will place her laundry after its return from the wash for an hour or two where the electric fan can "blow" on it. Any dampness remaining after drying and ironing at the laundry is removed, any odor of soap is destroyed, and a fresh sweetness imparted to the linen. Fine linens and laces preserve their whiteness better if dried by the fresh air; artificial hot drying injures expensive materials, and in damp weather they cannot be dried properly merely by being suspended in a room where there is little circulation of air.



Drying the Wash

If there is an odor in the room, due to fresh paint, varnish or recent papering, turn on your electric fan and note how soon this odor will disappear. This is also true of smells from furnaces, ovens, or stoves.



Airing the Sick Room

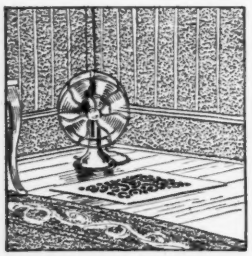
In the sick room fresh air is of paramount importance. A free access of pure air is often the safeguard against those ministering to the wants of the sick.

There is indeed no season of the year in which its usefulness cannot be proven, and winter is no exception.

Most important to the shopkeeper is the use of the electric fan in show windows to keep the frost off the glass. Unless some special arrangement is made to secure excellent ventilation of the show window, it will become so heavily coated with frost on cold days that the exhibits cannot be seen from the street. A fan in the window, however, will keep the air circulated so that the moisture that tends to gather upon the window will be evaporated.

Clearing a show window

The fan is very useful in aiding the heating system in the home, especially where a hot air system is employed. Every one who has ever tended one of these furnaces knows that it is frequently impossible to make the hot air rise through certain pipes when the wind is blowing in the wrong direction. A fan placed directly in front of the register will draw the hot air through the pipes and heat the room very quickly. The writer knows of a number of cases where the cold air intake pipe is so arranged that a fan may be placed inside, thus increasing the circulation of the furnace. Who has not gone to his furnace to find it cheerless and depressed with hardly a spark visible? In such cases the most drastic arrangement of drafts will fail to save the fire, but if there if any life left in the fire pot whatever, a fan placed in front of the lower door will soon have the coal blazing merrily.



Helping heat a room

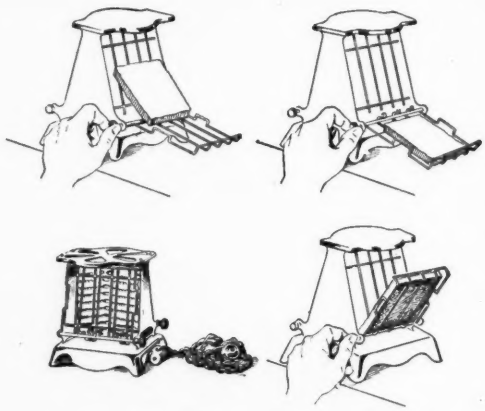
When the kitchen is filled with smoke from an unruly range an electric fan placed in the window will quickly clear the atmosphere without drawing in a large volume of cold air.

Many women use a fan to dry their hair after a shampoo by placing it upon a radiator and sitting in the draught.

Electric Toaster Eliminates Burnt Fingers

TO those who have frequently burned their fingers while turning over the toast on their electric toaster, the new toaster recently added to the electric devices now on the market will prove an interesting improvement.

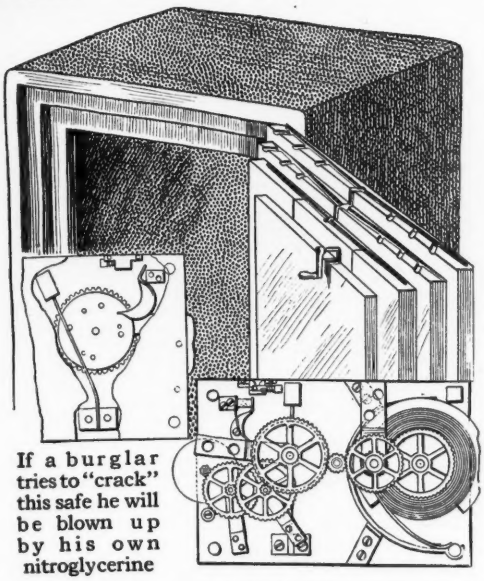
By turning the knob near the bottom, the frame holding the slice of bread to the heater coil is thrown outward, while wire catches at the bottom trip the toast so that it slides along the frame, browned side down. On turning the knob back again, the toast is raised to a vertical position with the fresh side toward the heater. By this ingenious arrangement it is not necessary to touch the toast with the fingers until it is ready for buttering.



The new electric toaster and sketches showing how it turns the toast without picking up with the fingers

Don't Decarbonize Aluminum Pistons

OWNERS and drivers of automobiles in which the pistons are of aluminum alloy, should be very careful in using "decarbonization" methods. Unless all experiments are wrong, it is bad policy to use the oxygen-acetylene flame for this purpose. Aluminum oxydizes much more rapidly than iron, under the influence of oxygen, and in the extreme heat of the oxy-acetylene flame still more rapid oxidation is probable. Until exact tests show that the oxidation is not fast enough to worry the motorists, the latter should steer the safe course and use some other method.



If a burglar tries to "crack" this safe he will be blown up by his own nitroglycerine

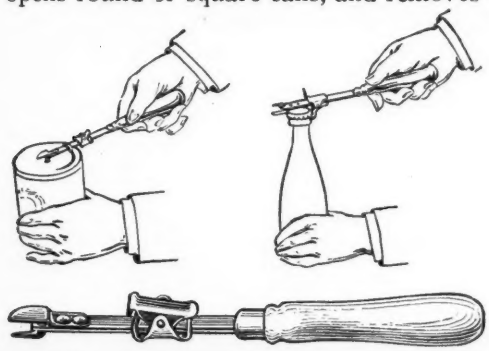
Foiling the Safe Blower

GROOVES are made in the upper edge of the safe door, so that in case nitro-glycerin is poured into the crack of the door, it will flow through these grooves to an element which may be destroyed without injuring the rest of the safe. Upon disintegrating, this element sets free a spring motor mechanism which operates a rotating hammer. The hammer strikes a succession of blows upon a percussion pin. Thus the nitro-glycerin is exploded prematurely and the successful blowing of the safe is prevented.

This Can-opener Cannot Slip

A NEW can opener, which locks fast so it cannot slip and cut the hand, has been placed on the market. It also opens round or square cans, and removes metal caps from bottles and tins. The tool is prevented from slipping by an adjustable lock, which can be moved back and forth and made to fit any size can. This lock is composed of a cutting edge fastened to a movable clip. The cutter is adjusted for the can to be opened. It operates on a central pivot as in one of the old-fashioned can openers.

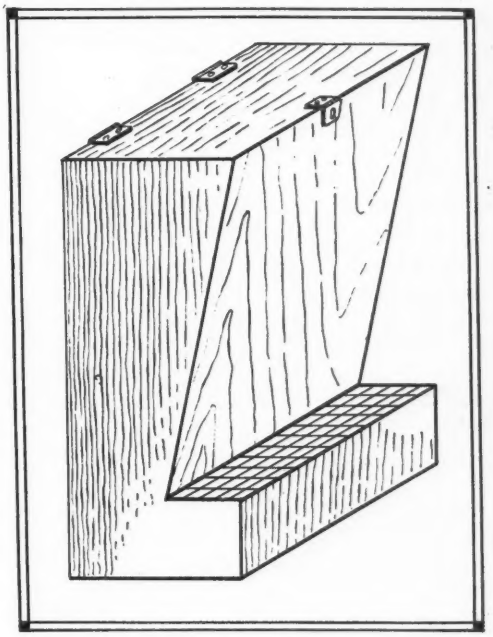
Square cans are opened by this tool with a cutting knife of the other type, also arranged so that it cannot slip. A hooking device is attached for removing metal capping corks for bottles.



This new can opener does not cut fingers. It opens bottles as well as cans

A Feed Hopper for Chickens.

A FEED hopper for chickens can easily be made by sawing the sides of a laundry soap box as indicated. A lid is fastened on the top by hinges, and the feed is poured in at the top. The front slants, which keeps the feed always sliding down as it is taken out of the opening. The opening is covered with chicken wire to keep the fowls from stepping into the feed and fouling it. The dotted lines show the original construction of the box.



The slanting front of this hopper is sufficient to keep the supply of grain in the screened feed box constant

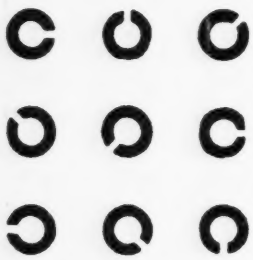
Left-handed Watches for Left Handed People

A WATCH for left-handed people has been invented by a Kalamazoo jeweler, who believes that the left-handed look at things in a "left-handed" fashion. The left-handed watch runs backward. The dial is arranged so that the numeral 1 is on the left hand of 12 instead of on the right as in the case of the ordinary watch. The hands also run from right to left instead of in the usual fashion. Mechanically, with the exceptions given, the left-handed watch differs very slightly from the ordinary time-piece.

The inventor constructed the unusual watch for the benefit of his daughter, who is left-handed.

An International Test for Vision

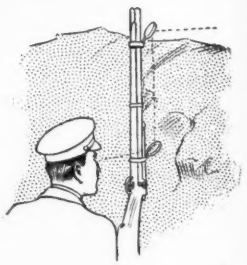
THE International Ophthalmic Congress at Naples, in order to introduce uniformity in methods of measuring vision, has adopted the broken ring of Landolt as the best possible international test for visual acuteness. But as no efforts have been made to use it as cards with test letters are used, it has had little practical value.



However, Dr. Edward Jackson, of Denver, has found that if the broken rings are arranged in a symmetrical group and printed, as here illustrated, on a card that can be turned with any edge uppermost, it constitutes a test independent of a knowledge of letters. The test is placed five meters from the patient. If the direction of the break in the rings is recognized at full distance, full acuteness of vision is demonstrated. If at four and a half meters, the vision is one-tenth defective, and so on.

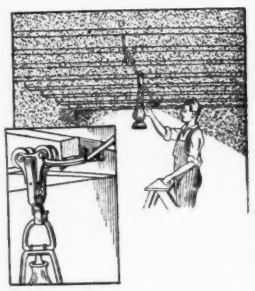
A Pocket Periscope

ONE of the interesting inventions which the war in Europe has stimulated is a very small, but none the less serviceable, pocket periscope. The soldier, concealed behind an intrenchment, can quickly attach this tiny instrument to the barrel of his rifle, to a pole, or to a trench-digging tool, and can readily observe, by means of the two circular mirrors, the movements of his antagonists in the distance without exposing himself.



A Trolley for the Stable Lamp

THE problem of carrying an oil lantern while at work in a barn or garage is an old and perplexing one, but it has been ingeniously solved by an inventor in South Dakota. Instead of depositing the lantern on the floor, on an upturned box, where its light is usually shed to the least advantage, he has devised a simple but effective overhead trolley system. A stout wire is extended across the ceiling between braces, and the lantern suspended on a small wheeled truck from it.



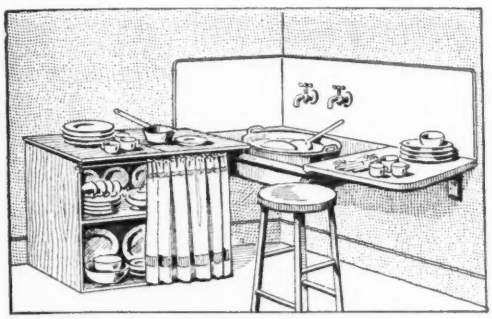
Non-Rolling Nursing Bottle

SO many babies these days are bottle-fed that mothers will be interested to know of a new feeding bottle which is flattened at the sides to prevent its rolling over either when baby is feeding or when the mother is washing the bottle. The ounces are scaled upon one side and the rim of the neck is so sloped that the nipple is easily put on.

The Home Craftsman

An Extra Drainboard for the Kitchen Sink

A SUPPLEMENTARY drainboard combined with a handy utensil cabinet can be attached to a kitchen sink which has only one inadequate drainboard. One end of the new drainboard rests upon the edge of the sink, while



The extra drainboard and cabinet is easy made and fills a space that is not needed as a rule

the other is supported by legs constructed as shown in the accompanying drawing. Beneath the drainboard, shelves for plates and tinware can be installed and a curtain hung in front of them to improve the appearance.

To Lengthen the Life of a Necktie

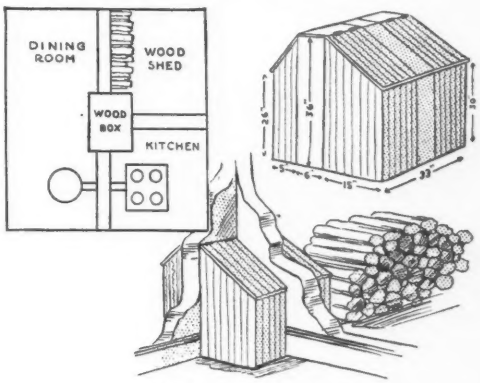
A GREAT many people who are users of four-in-hand ties are more or less bothered by the tie's becoming useless after it has been worn a few times.

Take the wide end of the tie with seam up and lay it flat upon a table. Then thrust in the finger and seize the lining. Take the silk cover in the other hand and pull it over the lining, about half of its length. A hot iron is then run over the lining to straighten it out.

To bring back the silk to its original shape is very easy. Lay the tie flat upon a table and pull the silk cover back very gently. Then after the tie is back to its original shape a hot iron is run over the whole.

Wood Box Arrangement Saves Many Steps from the Dining Room

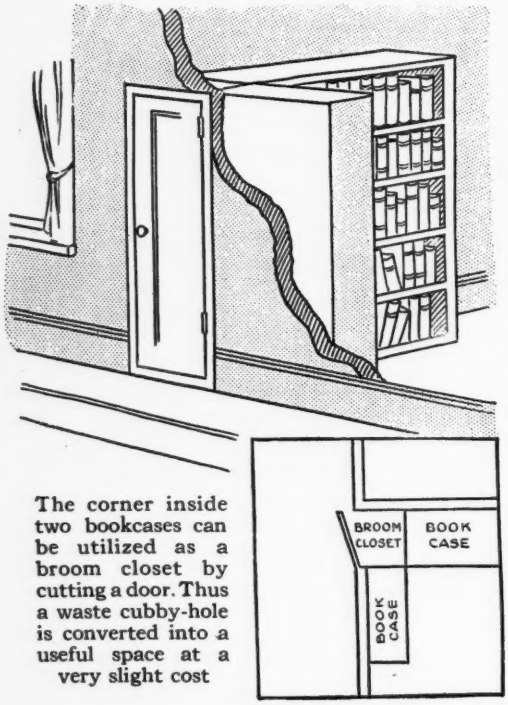
THE task of bringing in wood for several stoves, which is supposed to have caused anguish to almost every small boy, can be solved in an ingenious way, provided the woodshed adjoins the house. If a houseowner is fortunate enough to have an arrangement of rooms, such as is indicated in the drawing, he can save many steps, by the expedient suggested here. At the juncture of the two walls a hole large enough to accommodate a kindling wood box should be sawed. The box may or may not be provided with lids, as desired. When wood is needed for the stoves in either the dining room or kitchen it can be taken from the box. The box can be easily replenished from the woodpile.



How a wood box can be built into a house and connected with the wood shed, so as to save useless walking from room to room

Broom Closet Utilizing Waste Space

IN a Chicago house book cases are built in around one corner of a living room. At the joining of the two cases there is a small waste space, not to be utilized for shelves and covered at the top by a broad shelf which finishes off



The corner inside two bookcases can be utilized as a broom closet by cutting a door. Thus a waste cubby-hole is converted into a useful space at a very slight cost

the cases five feet above the floor. As the kitchen is immediately behind the room this little waste "cubby hole" has been "tapped" by a narrow door opening into the rear room. It is just large enough to hold the broom and dust cloths.

A Cheap Septic Tank

A PERFECT septic tank can be built at a small cost by following the plan here illustrated. A tank six feet long by three feet square (inside measurement), will answer the requirements of a family of six people.

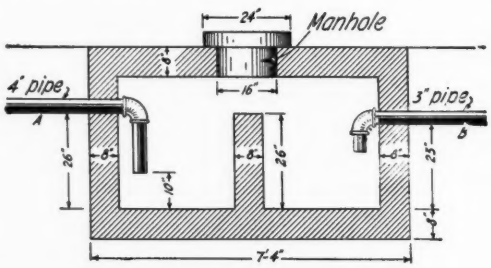
After digging the hole, and before placing the form, fill the bottom of the hole with 8″ of concrete, mixed five to one. Then place the form upon the concrete making sure that there is a space of no less than 8″ between the form and the sides of the hole. Set the form so that the top is level; then fill all around with concrete. Tamp the concrete in well, being sure not to use any large stones, as the tank must be water tight.

Next comes the top. Cover the form over with boards, leaving a hole in the center sixteen inches square for the manhole. Build a box around this eight inches high. Then cover the top of the tank with concrete, being sure to have it smooth around the hole.

The concrete work should all be done at one time, so there will be no seams in the work.

For the cover of the manhole make a frame twenty-four inches square and four inches deep; fill this with concrete and let it stand until dry and hard. The cover must be set in cement to insure an air tight joint, for unless the tank is air tight it will not work. After the concrete has set, remove all the forms from the inside. It is best to use a good rich mixture of cement around the inlet and outlet pipes to insure a good tight joint.

For A, the inlet, use common four-inch tile, and from B, the outlet, use three-inch tile. The tile may be run to a cesspool or may be branched out in two or three directions and used to irrigate a small garden spot. The tank can be set underground just far enough to have sufficient dirt over it to make



This form of home-made septic tank can be used with success by a family of six people

a lawn, as it will not freeze in cold weather. If it is air tight it will not have to be opened after putting in operation. It is a good plan to fill the tank full of water and let it stand a day or two, to be sure that it does not leak, before cementing the cover on.

A Craftsman Desk Chair

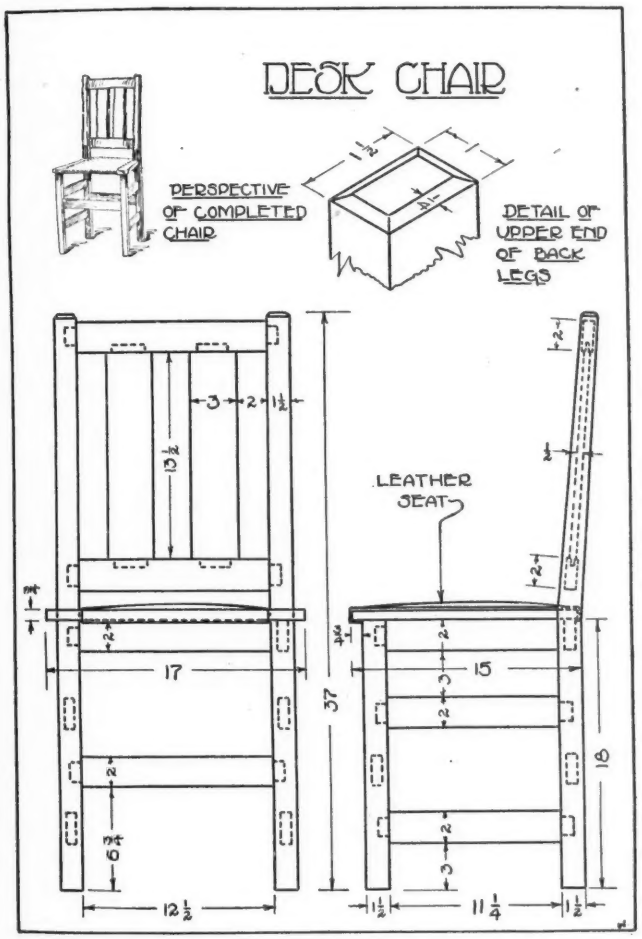
By Ralph F. Windoes

IN the October issue of POPULAR SCIENCE MONTHLY, the author presented a craftsman desk table. The chair herein described is its companion piece, but it would serve equally as well as a dining or an occasional chair.

The mill-bill for this chair is as follows, all pieces to be planed and sandpapered to exact dimensions at the mill. Of course, the lumber should be of the same kind and quality as was purchased for the desk:

2 pcs.	1½″	x 1½″	x 18″..	front legs
2 pcs.	1½″	x 3″	x 37″..	back legs
6 pcs.	¾″	x 2″	x 14½″.....	rails
6 pcs.	¾″	x 2″	x 13½″.	side rails
1 pc.	¾″	x 15″	x 17″.....	seat
2 pcs.	½″	x 3″	x 14½″	back slats

On one of our drawings a detail of the back legs is given. They are cut from the 1½″ piece, that is, 3″ wide, and should be very carefully laid out and worked up, as they are, in reality the most difficult part of the construction. If the craftsman desires, he may take this drawing with him to the mill, lay out these legs there, and have them sawed out on a bandsaw, which would save a great deal of the time and expense; otherwise they must be ripped out of the planks by hand. In smoothing them, plane as far as practical, and spokeshave the balance. Be very sure that you keep the edges square.



Elevations, showing dimensions, of the craftsman desk chair as the parts come from the mill

Selecting your working faces — noticing that the back legs are paired and that the mortises are not cut in the same face of each—lay out these mortises in pencil. Also, lay out the mortises in the front legs and compare the four in their proper position with respect to one another. As the tenon detail shows, the mortises will be 1½″ wide, 1″ deep, and 1½″ long.

Cut these mortises and fit their corresponding tenons in place. In the lower edge of the top back rail and the upper edge of the bottom, cut mortises for the slat tenons.

Next glue and clamp these sections together, placing the back slats first. Attach the seat by screwing into it through the side rails that it rests upon. The

seat must be cut out around the back legs.

Clean it up and apply the same finish that was used on the desk table.

The seat is covered with leather, padded over curled hair, as the detail shows. First the hair is carefully picked apart, and placed. Then a piece of cloth slightly smaller than the leather is tacked tight over the hair, and finally the leather is placed. It runs under the front and back edges, where common tacks are used, and along the edges on the top it is fastened with gimp tacks. These edges may be turned under, or a piece of gimp braid used under the tacks to cover the cut edges of the leather.

As this is the first project of this series that has required the use of leather, a few words on this very interesting subject will not come amiss.

Leather is the skin of any animal that has been tanned and cured. *Cloth* covered with any substance, and finished in any way is *not leather*. Thus we differentiate between *genuine leather* and its *imitations*.

There is no imitation that is better than genuine *grain steer* or cow hide leather, but there are a number of imitations that are better than some split leathers. A question that has been asked in printed matter circulated throughout the country is, "How many hides has a cow?" This question, written by a manufacturer of a leather substitute, was concocted to start the public thinking upon the subject of split leather. In itself, the question is certainly foolish, but it has undoubtedly accomplished its purpose. If the one hide of a cow were to be tanned and curried, it would be too thick to use for tufting loose cushions—in fact, any branch of furniture upholstering. Therefore it is necessary that the leather be split. As to "how many" times it can be split, there is some doubt. One leather manufacturer claims that he is able to split one steer hide into fifty whole parts, each about as thick as a sheet of tissue paper. Of course, such sheets of leather have no commercial value, whatever, but a performance such as this would serve to answer the foregoing question.

The usual method of splitting a hide, is as follows: First, the "top grain"—the best part of the leather, is removed; second, "special deep buff"—not as serviceable as top grain; third, "extra split"—used for very cheap leather furniture; and fourth, a "slab" that is left, of uneven thickness—used for inner soles of shoes, etc. This, the usual procedure, varies exceedingly in practice with the different manufacturers and the different kinds of hides. Comparing these with substitute leathers, we are very much of the opinion that no imitation will ever approach "top grain" in points of beauty, utility, and service. "Special deep buff," properly grained and enamelled, is, no doubt, much better than any imitation now on the market, but this is a debatable question, and we will leave it with the manufacturers to settle. An expensive imitation surpasses "extra split," especially for furniture purposes, but the cheaper, thin grades, are not to be recommended for any purpose. Of course, the "slab" is of no account for furniture work, and hence we will not consider it.

The making of good furniture leather is an interesting process. The green hides come to the leather manufacturer from slaughter houses in a wet salted condition. First the eye holes, nose, lips, ears and leg shanks are trimmed—these trimmings being later sold to manufacturers of soap greases and glue. The hides are next washed in clear water to remove the salt and dirt, and soften the texture. The fat is now removed from the meat side, and shipped to manufacturers of neat's-foot oil. Following this the hides are limed; that is, worked in a lime bath for a number of days in order to dissolve the fatty hair roots which will permit the hair to be easily removed. This by-product goes to makers of cushion fillings, etc. Next, the fleshy material remaining on the meat side is scraped off—this being sold for glue stock—and the hides are thoroughly cleansed of all lime and bacteria.

Now the hides are ready to be tanned. They are placed upon pivoted frames which are constantly agitated in a weak solution of tan liquor—oak bark, usually. Each day the strength of this liquor is increased, until on the eighth day the hide has received sufficient tan-

ning to be called leather." The excess water is now removed, and the skin "stoned," i. e., rubbed and ironed until the wrinkles are all removed.

Now comes the splitting—the most interesting operation to laymen. This is accomplished on a delicately adjusted machine having an endless knife traveling between two rolls. The upper, or "gauge" roll, determines the thickness that the leather will be split, while the lower, a "ring" roll made up of a number of small rolls independent of one another, forces the skin up evenly, so that any irregularities in the hide are not transmitted into the split. The leather is split, as has already been told.

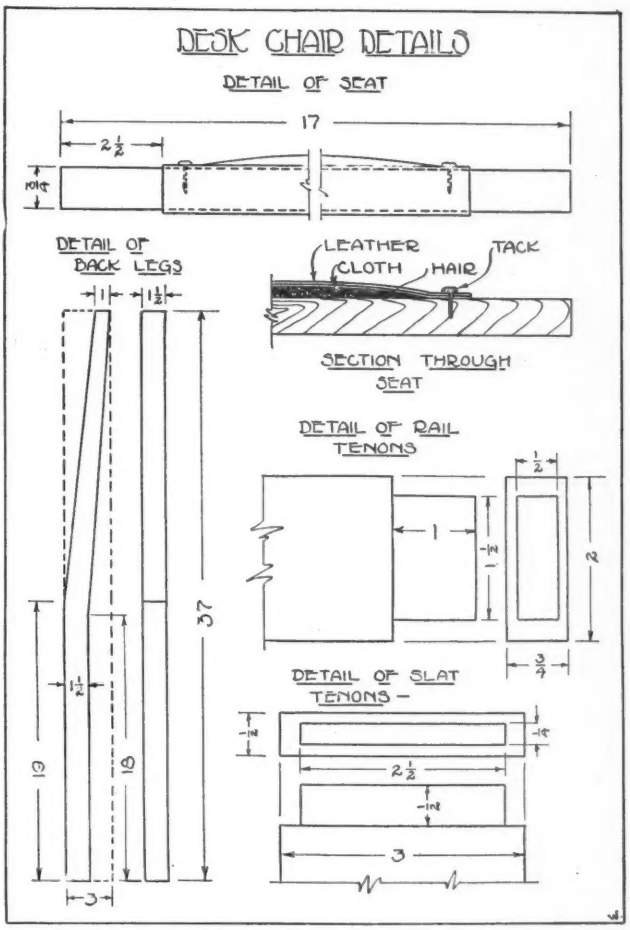
After splitting, all hides are re-tanned and thoroughly rinsed and scoured. Then follows a bath in a liquor boiled from the ground leaves of the sumac tree, which serves to brighten them and make them more pliable.

Next the leather is lubricated. This process is known as "stuffing" and consists in filling the fibres with a coating of cod oil and other greases. Both sides are treated in the case of top grains, and the flesh side only of splits. Now the leather is tacked upon frames where it is stretched and allowed to dry. After removal from these frames, it is softened, and made ready for the enameling.

This consists first of a number of coats of linseed oil—varying in consistency—which are allowed to dry before receiving the Japan. This also is applied in successive layers, allowing all to harden. Then the leather is taken to the embossing presses, where the attractive crevices are stamped into the splits. The top grains are usually not embossed in this way, as a special method of retanning accomplishes this. At this stage all leathers receive a coat of color, usually black, which is their finished surface. If the leather is found to be somewhat stiff, it is softened by rubbing with a cork armboard. After cleaning and measuring, each piece is rolled up ready for the market.

It is necessary to emboss all splits, and as this is a mechanical operation, a careful examination of the leather will reveal this repetition of design, while in the best grades, that are not embossed, this repetition of crevices will not be apparent.

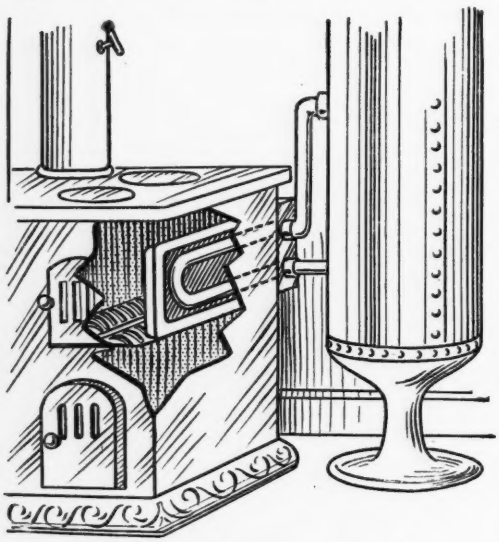
To clean leather, sponge with warm water softened with borax and rub with an old soft cloth; then rub in a few drops of glycerine and polish with chamois. To extract grease spots, rub softly with flannel dipped in ether.



Details of construction of craftsman desk chair

A Serviceable Hot Water Heater Which Can be Made at Home

A SERVICEABLE hot water heater can be made in the home, and it will give as satisfactory results as the more expensive ready-made heaters which are directly attached to the boiler. Pipes should be led from the center and



The home worker can make the connections and install this heater

bottom of the boiler, joining in a U-shaped pipe. Brass unions should be used as joints, being installed at the back of the stove. The water front, or heating unit, consists of the U-pipe, bent in a small enough radius so both sides are in range of the burner. It should be packed in place with fire clay.

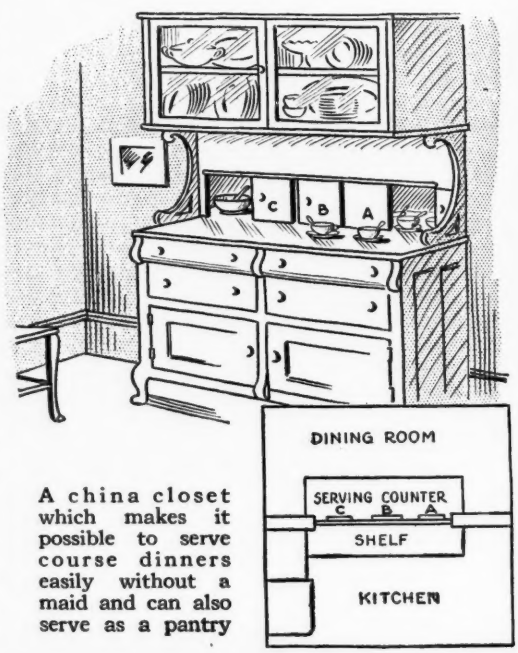
How a Course Dinner Can be Served Without a Maid

A CLEVERLY devised china closet is built into the wall between the dining room and kitchen, a long serving counter and the dish-storage shelves above it opening into both rooms. the linen and silver drawers opening into the dining room only. The sink and drainboard are on the kitchen wall adjoining the cupboard, which makes easy the putting away of dishes after washing. The range is as near as possible on the second adjoining wall, to save steps in dishing up a meal and placing it upon the counter.

The unique feature of the cupboard is that the dining room front of the serving counter is hidden from view, when desired, by three sliding doors. The kitchen face of the counter is uncovered. In serving a meal the housekeeper lays the table with the first, or soup course; places the second, or meat and vegetable course on the counter behind slide *B;* and the third, or dessert course, behind slide *C*.

Without returning to the kitchen she can later remove the first course and place it on the empty counter behind slide *A;* remove the waiting second course, which has been concealed by slide *B;* later, place the soiled dishes of the second course back behind this same slide *B;* and serve the dessert that is ready behind slide *C*. When the meal is finished she can put the remains of the dessert back upon the counter at *C*.

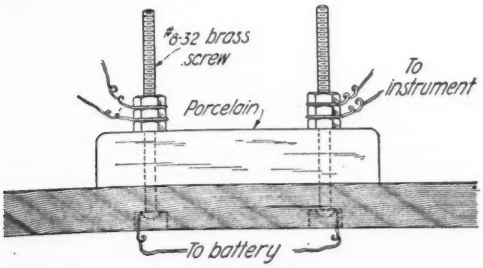
In preparing to wash the dishes she finds, upon reaching the kitchen again, that they are on the counter at her right, as they should be, and she scrapes and piles them upon the drainboard at her left. This makes it possible to route the process of dish cleansing from right to left, which is most efficient.



A china closet which makes it possible to serve course dinners easily without a maid and can also serve as a pantry

Connecting Block for Bell Wires

THIS connecting block is very handy for joining a number of wires from the same set of batteries, such as spark coils, door bells, light lamps, etc.,



As many bells as are wanted can be attached to one set of batteries by this simple connecting block

and as many wires as desired can be added by simply adding more nuts on the bolts. A good idea of it can be obtained from the drawing.

The base can be made of hard wood such as oak or maple. It has four holes drilled in it. The two nearest the end are for No. 10 wood screws, to fasten it on the wall or table. The other two are for the brass bolts. The bottom of the base where the bolt heads rest, is drilled in about ¼" inch with a ½" drill.

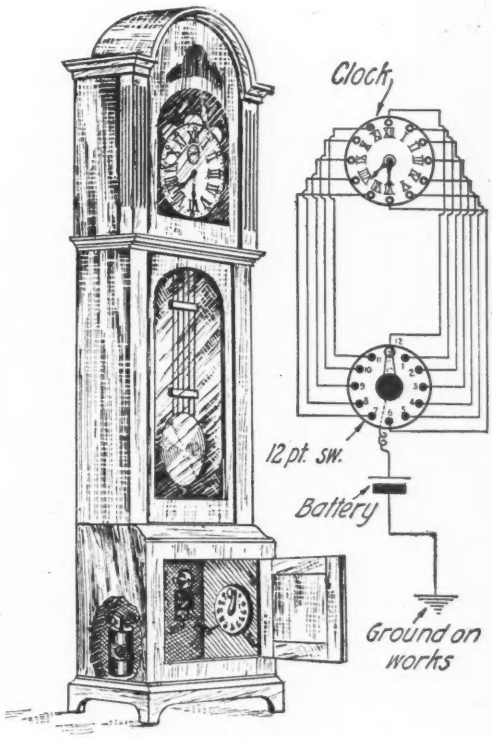
This is so the base to be level on the bottom when the bolts are inserted.

Ink Erasing Blotter

TAKE an ordinary sheet of blotting paper and steep it several times in a solution of oxalic acid or oxlate potassium and dry. While the ink spot is still moist apply the blotter and the ink will be extirely removed. If the ink is dry moisten and apply the blotter.

An Electric Alarm Clock

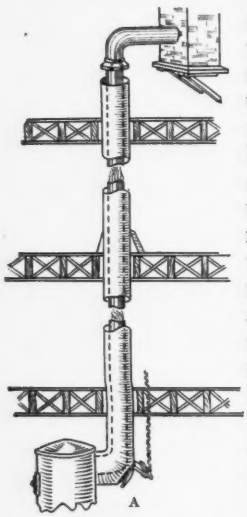
THE tall hall clock that is so frequently found in the halls of old-fashioned houses can be readily converted into a very serviceable and effective electric alarm clock without in any way impairing the dignity of its appearance. The face of the clock, if mounted on metal, should, as the first step, be removed from the metal and remounted on a wooden back, so as to provide proper insulation. Bore ⅛" holes beside each of the figures as shown in the sketch. Each of these holes should receive a copper rivet long enough to extend 1/16" above the face of the clock. Soldered to the back of each rivet is a copper wire of the kind used in bell wiring. By means of 12 such wires, the rivets in the face of the clock are connected to the contact points on a 12-point switch, which is numbered to correspond to the figures on the dial. A dry battery, concealed in the base of the clock, is connected with the works at one terminal, and to the bell and switch at the other pole. Now solder to the small hand a very fine spring wire so that it will come in contact with the copper rivets beside the numbers. To set the alarm, for example, at 6 o'clock, turn the switch handle to the number 6. When the hour hand comes in contact with 6 on the dial, the bell will ring until the switch is turned off, or until the hand has moved away from the contact. By using a pleasant bell, harsh sounding effects may be eliminated.



How to make a grandfather clock into an efficient alarm clock without changing its outward aspect

A Fuel Economizer

A CONSIDERABLE portion of the heat from the ordinary home furnace escapes, by way of the flue-pipe and chimney, into the open air. Consequently, if this wasted heat could be diverted into the rooms of the house, less coal would be required; and more heat could be produced from the coal used. The device shown in the illustration, which should be installed with the heating system, consists essentially of two pipes of sheet metal, one enclosed within the other. The inner pipe is the flue; and the outer enclosing pipe, which should be 4″ or 5″ larger in diameter than the inner pipe, carries the air from the cellar up along the hot flue pipe. The air enters the outer pipe by way of the opening at A; and as the air rises, it absorbs the heat from the flue. Directly above the floor on each story, a register is installed in this outer pipe; and the hot air, which is ordinarily wasted, is thus used to heat the rooms. The outer pipe should be led into the attic, where it terminates, and a ring should be placed over its open end to prevent the entrance of dust and particles of wood into the device. The inner pipe, of course, enters the chimney in the usual way. To increase the efficiency of the outer pipe, it is advisable to cover it with a layer of asbestos, which insures the escape of the heat only at the registers on each floor.

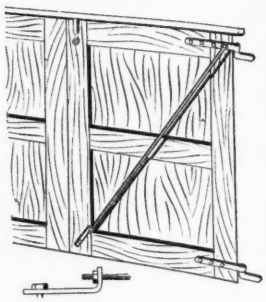


Helping to Kindle Fire Wood

SMALL kindling can be fired quickly if the wood is dipped in a hot solution of two quarts of tar and six pounds of resin. When this is cool, fine sawdust and powdered charcoal should be added until a thick consistency is obtained. This mixture should be spread in a layer one inch thick over the kindling wood.

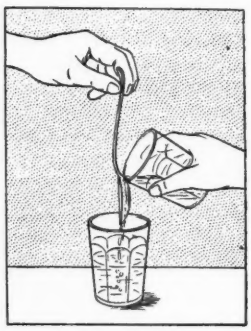
A Remedy for Sagging Doors

THE tendency of heavy swinging garage or barn doors to sag can be rectified by proper bracing. Two ¼″ iron rods are fitted diagonally inside the doors from the lower outer corner to the hinge in each upper corner. The rods are bent in the shape of an eye at one end and threaded at the other. The eye is bolted to the hinge while the threaded end is passed through the flange of an L-shaped iron cleat held down by a lug. A nut which holds the rod in the cleat serves as a turnbuckle for raising the door to its original position.



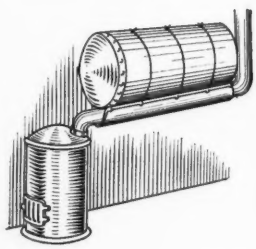
Pouring from Lipless Jars

LIQUIDS are likely to be spilled when pouring from a vessel that has no lip. If a glass rod is held against the rim it conducts the liquid where it is required and with care not a drop need be lost.



Waste Heat Warms Water

THE wasted heat from a small gas heater can be put to work, warming water for household use. A small stove pipe should be led from the top of the heater and underneath a hot water tank placed in a horizontal position. A section of eaves trough to cover the pipe in its contact with the tank will save much heat.



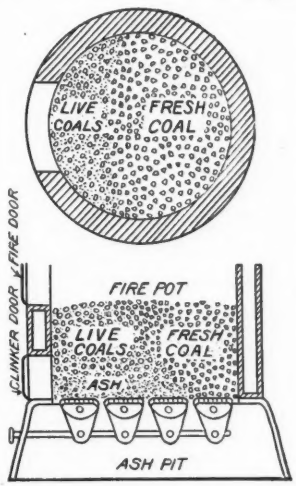
Hints on Running the Home Furnace

TO get the best heat at the lowest cost and with the least expenditure of time and labor, a number of valuable suggestions have been prepared and issued by the United States Department of Bureau of Mines. Here are some:

Attend to the fire regularly, and do not wait until it has burned low and heat is needed throughout the house.

Let the size of the coal fired be as nearly uniform as possible. Using a coal of uneven size prevents an even flow of air through the fuel bed and increases the tendency of the fire to burn through in spots. Try to keep the fuel bed free from air spots.

Avoid excessive shaking of the grates and thus reduce the amount of coal lost by falling into the ash pit. Ordinarily the shaking of the grates should be stopped as soon as bright particles begin to drop through.

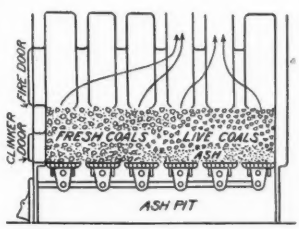


Round fire pot fired by coking method

In mild weather it is well to leave on the grates a layer of ashes under the active fuel bed. This layer will increase the resistance to the flow of air through the fuel bed and will facilitate the maintenance of the low rate of combustion required in such weather. It will also cut off some of the grate surface.

Clinkers should be worked out of the fuel bed, for they obstruct the flow of air, clog the grates, and may break the parts of the shaking grates.

Keep heating surfaces and flues swept clean so they will readily absorb heat. Do not let ashes pile up under the grates in the ash pit, for they will seal off the air from part of the grate surface and may cause the grate bars to become burned and warped.



Square fire pot fired by coking method

Ascertain by experiment what operating conditions produce the best results in your particular heater and adhere to them as rigidly as possible.

Insufficient draft is often responsible for failures of heating systems to meet requirements. The chimney or smoke pipe may be too small, or may be obstructed, or may have leaky joints.

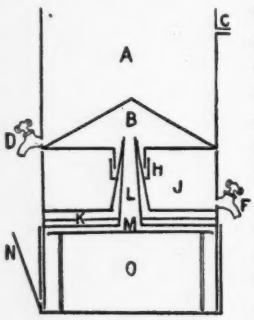
The importance of providing an inlet for the air that must enter the furnace room is frequently overlooked. Roughly 150 to 300 cubic feet of air are required for each pound of coal burned, and to prevent trouble from insufficient draft, some means for admitting this air into the furnace room must be provided. Usually enough air leaks into the furnace room through cracks and poorly fitted windows, but the tighter the construction of the room the greater the need for an outlet.

The person most likely to be interested in proper methods of operation is the one who pays the fuel bills, and as a rule it is to be expected that better results will be obtained if the firing is done by the household rather than some one hired to tend the fires. However, something more than an interest in keeping down the coal bills is necessary; some knowledge of the characteristics of the fuel and the functions of the different parts of the heater is required to save fuel and trouble.

Use the coking method of firing as shown in the illustrations; that is, work the partly burned coal, from which the gas has been driven, to one part of the fire and throw the fresh coal on the remaining portion. The fresh fuel then ignites slowly, the combustible gas is driven off gradually, and the live coals that are exposed on one side of the fire heat this gas, so that it is burned before it leaves the fire pot. If fresh coal is spread uniformly over the fire surface, much of the gas driven off is not ignited and escapes unburned.

Distilling Water for the Household

FOR the housewife who wishes to be sure that her family is drinking perfectly pure water, the new home water still is most important. It is made of copper and lined throughout with tin, as this metal is unchanged by distilled water. The device consists of three drums, one upon the other. The bottom one is the boiler, the middle one is the reservoir for the distilled water, and the upper one is the condensing chamber above which cold water is placed to cause the steam which rises from the boiler to condense.

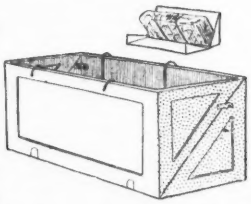


To obtain distilled water, the boiler and cold water chamber are filled and the still placed on the stove. The distilled water falls into the reservoir (middle drum) through a water seal (L). This seal is an important improvement over the ordinary still because it confines the steam from the boiler, thus increasing the pressure in the condensing chamber and giving twenty-five per cent more condensation with the same amount of heat. The distilled water may be drawn off at any time through a faucet, and the water in the cooling chamber allowed to flow from a faucet into the filling aperture of the boiler to replenish it.

Making an Electric Toaster

MANY experimenters wish to make resistances for electric toasters and heaters but are at a loss to know how to wind the resistance coils for it. The following method of winding the coils of wire will be found practicable. The wire used should be about No. 22 (B. & S.) iron wire, such as is used in basket making. Remove the handle from a hand drill and fasten the drill in a vise so that the crank can be revolved freely. Put a 3/16″ rod, 5″ long with a 1/16″ hole through one end in the chuck. Cut the wire into about 10′ lengths and put one end of a piece of the wire through the hole in the rod and as the crank is turned the wire will be wound on the rod in an even layer. Each piece of wire gives a coil, closely wound, 4″ long. Remove the end of the wire from the hole and the coil will slip off the rod. When the coils are stretched over a frame of wood so that they are 6″ long the adjacent turns of the coil will no longer touch. In this way one can wind 120 coils in one afternoon.

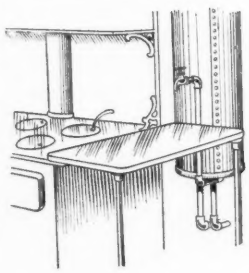
A Home-made Paper Baler



HOW to dispose of waste paper is a problem that is often presented to the city dweller. The accompanying sketch shows how accumulated paper may be baled in a simple apparatus. Use a strong wooden box about 22″x28″x30″, and strengthen the corners with angle irons. Saw the ends apart diagonally, and by means of two step hinges join the two halves together.

Two baling wires should be hung from the inside of the box. Paper placed in this box can be pressed down until a bale weighing from 40 to 50 lbs. is produced. After the bale is wired, it can be easily removed and taken away by the junk man.

Serving Table Attached to Range



A SERVING table that can be attached to the range will save much time for the housewife in the kitchen. Referring to the drawing, the board is attached to the stove by means of braces and rivets.

To the right of the shelf is the hot water boiler. A faucet may be installed in the boiler above the shelf.

Well seasoned wood should be used, and covered entirely with a layer of sheet copper.

For Practical Workers

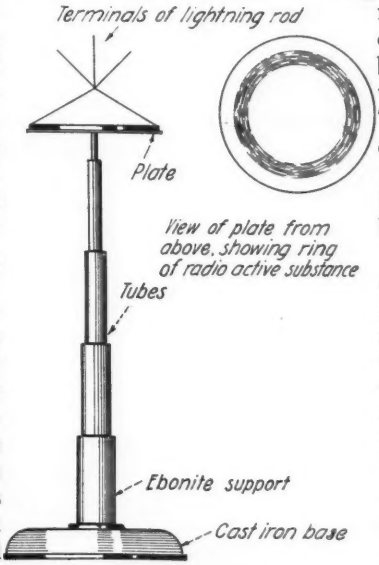
A Radium Lightning Rod

By Lucien Fournier

A LIGHTNING ROD does not prevent the occurrence of lightning. It even provokes it, but suppresses its incendiary effects. Such, indeed, is its chief object.

May we not increase its efficacy in this direction? The problem is an interesting one. We know that if the air were a very good conductor of electricity there would be no electrical storm. All that is necessary for our purpose, therefore, is to give the air this quality artificially.

Nothing is more simple—we need only to *ionize* it. To ionize the air is, so to speak, to "metallize" it by means of infinitesimal particles like those which are given off by radium and which are discharged into the surrounding space from the point of emission. From the recognition of this fact to the construction of a radium lightning rod was only a step. Its construction is not difficult; it is only necessary to put a few milligrams of radium on a plate, installed on a lightning rod near its terminal. The inventor of the process has constructed an experimental rod consisting of three brass tubes fitting into one another and having a total length of about 12 feet. The tubes are mounted on a massive support of ebonite, resting on a cast iron base fixed in the ground. At the summit of the apparatus is a cluster of three points, and below them the plate containing the radio-active substance. This plate, slightly convex upward, is of copper, about one-tenth of an inch thick and ten inches in diameter. The radio-active substance is spread in the form of a ring on its upper surface, the ring being about three-quarters of an inch in breadth and concentric with the edge of the plate. The amount of radium is only 0.2 milligramme (about .003 grain), and it is deposited on the plate by electrolysis.



A radium lightning rod which depends on the ionization of the air for efficacy

What effects are produced by this small amount of radio-active substance upon the surrounding air? The inventor declares that the conductivity of the air is increased several millionfold, and that this conductivity extends to a considerable distance from the point of emission, viz., the terminal of the lightning conductor.

Under these conditions the passage of electricity will take place between earth and air, not by brusque, irregular discharges, limited to a single point, but by a constant, steady current passing through a column of air having a radius of thirty or forty feet. The progressive conductivity of the air toward the terminal concentrates the flow of

electricity in that direction. Moreover, the radio-active emissions have the effect of reducing the potential gradient and preventing explosive discharges between the cloud and the lightning rod.

It is easy to see the advantage of this arrangement. The difference of potential between the two electrified bodies being small, the spark will be of moderate intensity and the discharge unimportant; moreover, it will always take place by way of the lightning rod, and not at some distance therefrom, as often happens, on account of the ionization of the air around its point.

A Glue Scraper

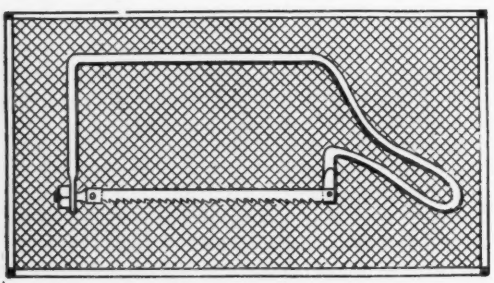
INSTEAD of buying glue scrapers for the shop, convert some of the worn-out files into useful articles.

Heat the end of a file red hot and beat it down to a sharp edge at the anvil. Then heat again and at a point about 1¼ inches from the sharpened end, bend over at right angles. This end of the file should be heated again after bending and plunged into cold water to harden the steel, so that the sharp edge will last.

This instrument will make an excellent glue scraper which will render efficient service in cleaning glue from jointed boards, and also from the top of the bench or work-table.

An Emergency Hack Saw

A SIMPLE yet efficient hack saw to fit an emergency can be made from a piece of iron wire ⅜ in. in

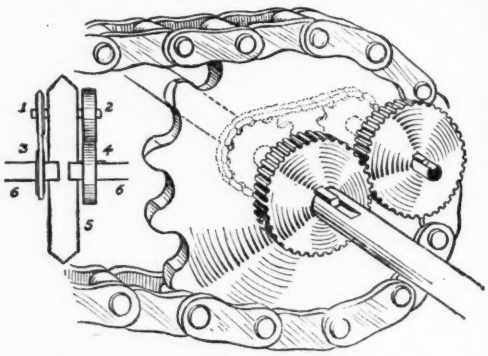


A hack-saw frame can be made from a piece of stout wire

diameter, bent as shown. The length depends on the size of the blades used. The wire is flattened at each end, and the blade is made fast by a rivet.

Differential Gear for Home-Made Tractors and Cycle-Cars

A differential gear that can be made for home-made tractors or cycle cars consists of a main sprocket, or gear, mounted to run loosely on the ends of the two-piece counter-shaft, 6. The sprocket, and spur gear, are keyed on a short shaft which turns in a pillow block. The pillow block is bolted in the



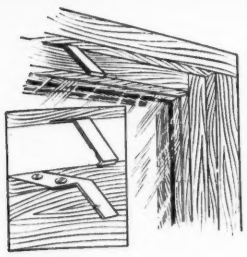
How to make a differential gear for a home-made tractor or cycle-car

main wheel about one-third of the distance from the rim. The sprocket, and the gear, are keyed on the two counter-shafts. The small gears mesh together. An endless chain belt connects sprockets 1 and 3

A Useful Home-Made Glue Brush

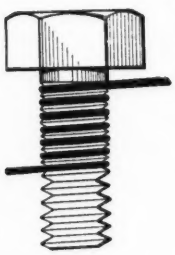
AN excellent glue brush for the cabinet maker or carpenter can be made from a piece of elm tree bark, which may usually be found in the yard of a furniture factory, wagon shop, or any hardwood lumber yard. With a sharp knife, whittle away the brittle outer bark down to the white fibre, or inner side of the bark of which the brush is to be made; cut a piece of this to the length and width required for the brush; soak one end of this piece in hot water for a few minutes; lay the water-soaked end on a hard substance, such as a piece of iron, or hardwood, and beat it out with a hammer, dipping it in the water occasionally to keep it thoroughly wet. The beating will cause the tough fibres of the bark to separate at the end, these forming an excellent and inexpensive brush, which never sheds hairs and lasts longer than the cheap brush commonly sold at the stores.

An Effective Window Lock



AN inexpensive and effective window lock may be made by the average man with a few tools from a piece of sheet steel. Two steel pieces are cut out according to the design illustrated, and bent to a slight angle, care being taken that both are bent to exactly the same degree. One piece is made about one-quarter of an inch longer than the other, and is bent at right angles, so that the other piece will strike against it, and be prevented from passing. When the window is closed, the device is in operation, and because of the projecting end of the longer piece, the window cannot be opened. The device is released by inserting a screw-driver between the metal strips and bending them in order to disengage the catch.

To Make Small Springs

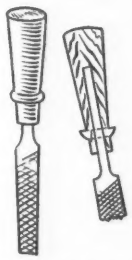


IN making little springs of small-sized wire take a machine screw and wind the wire tightly around it in the threads. This brings the spring out as closely as most home-made springs need be. A slight pull will stretch it to the desired length. A screw somewhat smaller than the size of spring desired should be used to allow for the resiliency of the wire.

How to Case Harden Iron

MAKE up a paste of powdered prussiate of potash and water. Coat the iron with this paste, and set it aside to dry. Let the forge fire be clear and bright. When the paste is dry upon the iron thrust the iron into the fire until it is cherry red. Keep it at this heat for a few minutes and then take it out. Plunge it into cold water, and it will be found converted into steel at the surface.

Files and Tools from Switch Handles



FIRST procure the required number of switch handles. Remove the usual screw. Into the hole left by the screw, force the tang of the file or other tool.

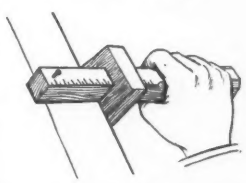
As most of these switch handles are made of wood, there is a metal ferrule on the end which serves to keep the handle from splitting. This ferrule serves the same purpose when a tool is inserted into the handle. Tools vary in size but different sized handles may be used for different sized tools. If a supply of these handles is kept handy a handle may be fitted to a tool at any time.

A Handle for a Small Bit or Drill

A CONVENIENT handle for small bits, drills or screw drivers which are intended for use with a brace can be quickly made from an old spool about 2″ long. If the square end of an old or discarded bit is at hand, drive it slightly into the hole in the spool, so as to make the hole square.

After this is done the spool can be placed on nearly any size of bit, to hold securely.

An Easily Made Marking Gauge

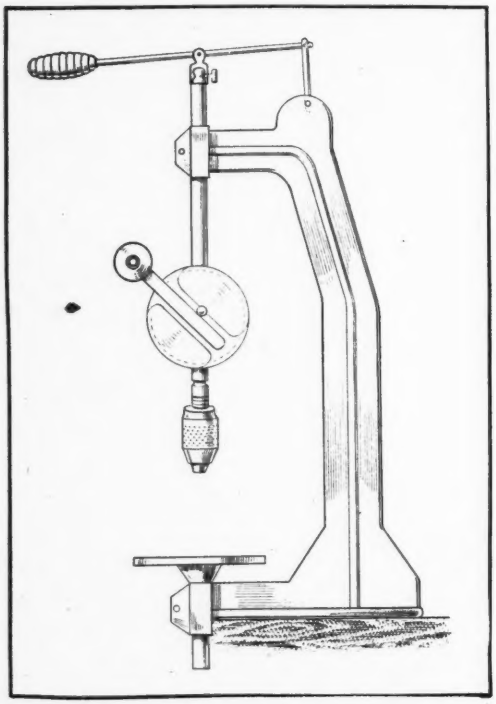


INTO a ¾″ dowel of wood, about 8″ long, drive a 1″ wire brad ¼″ from one end and let the point protrude ⅛″. Take a rule and lay off sixteenths from the nail. Drill a ¾″ hole through a block of wood 2½″ x 2½″ x ⅞″. Then slide the block on the dowel. The friction is enough to hold it for marking. By tapping the dowel with the block held in the hand, the marking distance can be lengthened or shortened, as may be desired.

Home-Made Drill Press

EVERY lathe owner knows what an unsatisfactory job drilling in a lathe is, and a great many cannot afford to indulge their hobby to the extent of purchasing a drill press.

The following is a description of a drill press which employs the ordinary



A drill press made from an ordinary round-shank breast drill

round shank breast drill and two castings, the patterns of which were homemade, as was also the drill table, which was turned in a foot-power lathe.

The attractive feature of this drill press is that the breast drill can be removed in a few minutes' time and used in the regular manner, and in the same length of time it can be reassembled.

To begin with, the breast drill must be one of the round-shanked type, which retail for about $1.50, and with a range of from 0 to ½ inch drills.

In the drawing may be seen the main casting. The casting is very securely fastened by screws to the bench. The pattern should be made of ¼-inch stock, with the sides ribbed ¼ inch so as to give greater strength. The bearings at the top and bottom should be cored a sufficient size to be liberally babbitted. The lugs are slotted with a hack saw and drilled and tapped for adjusting screws at the top and for a clamping bolt at the bottom.

The drill table is self-explanatory; the shank and surface being the only parts that require machining. If the builder has a lathe this can easily be done; but if not, a machinist will do the work at a low cost.

The feed lever is made of 3/16 x ½ inch iron or cold-rolled steel. Two pieces are hinged in an L form. The socket for raising and lowering the drill is made of pipe fitting, such as is used on awnings, lapped for a set screw.

To babbitt the casting a jig must be used in order to align the table with the drill properly. For this purpose procure a piece of steel of the same diameter as the shank of the table. Turn down one end sufficiently to be gripped in the drill chuck, and with this rod it becomes possible.

How to Get the Most From a Football

AS a rule the tube of a football bladder will crack off before the bladder is worn out. This is due to the bending of the tube.

A bicycle valve cap will protect the stem and a pump may be used to blow up the football.

To do this coat the outside of the valve with shellac, being careful not to let any get on the stem, and insert it in the tube. Wind a shoe string around the outside of the tube to hold it firmly against the valve. When the shellac has set the shoe string may be removed.

A Help in Wire-Twisting

CUT a notch in the center of a screw driver blade, about 1/16″ deep, as

A notch in a screw driver gives a grip on wires to be twisted around binding posts or sockets

shown in the sketch. This will be found of great aid in bending wires around binding posts or sockets.

Ground Detector for Three Wire Circuit

NEARLY everyone is familiar with the method of connecting a couple of incandescent lamps whereby they will indicate the presence of grounds on a two-wire system. For such service the two lamps are connected in series between two of the wires of opposite polarity of the two-wire system, and a ground wire is tapped between

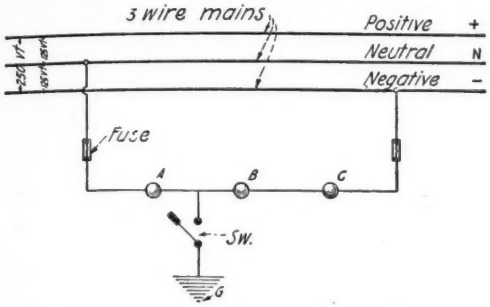


Fig. 1. Wiring diagram of a three-circuit ground detector

the two lamps. Where a ground occurs on the circuit, the lamp connected to the wire on which there is a ground will grow dim or will go out altogether, and the other lamp will burn above normal brilliancy.

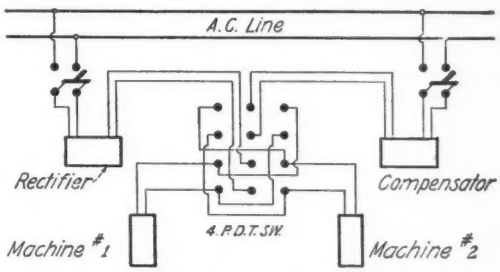
The method of connecting incandescent lamps to indicate grounds on a three-wire system is not, apparently, very well known. It is, however, simple in arrangement and operation, as indicated in Fig. 1, and described in the following paragraph.

The three lamps, *A*, *B* and *C*, are connected between the neutral and the negative wires or between the neutral and the positive wire, as shown. Each of the lamps should be designed for the voltage between either of the outside wires and the neutral. For example, the voltage between any outside wire and the neutral is 125. Consequently *A*, *B* and *C* should each be a 125-volt incandescent lamp.

The three lamps connected in series should be protected with a fuse at each tap as shown in the figure. A lead between lamps *A* and *B* with a switch in series should be connected to the earth. With the three-wire system free from grounds all three lamps, *A*. *B* and *C*, will burn dimly, whether the ground switch *GS* is open or closed. If, however, an accidental ground occurs on the positive wire, all of the lamps will burn with full brilliancy if *GS* is closed. If a ground occurs on the negative wire and *GS* is closed, lamps *B* and *C* will not illuminate, but *A* will burn at full brilliancy. If a ground occurs in the neutral wire, *GS* being closed, *A* will not burn, but *B* and *C* will burn dimly. The switch should always be connected between the lamps (*A* in this case) which connects to the neutral wire and the next adjacent lamp. If it were connected between *B* and *C*, in case of a ground on the positive wire, lamp *C* would have double voltage (250 volts) impressed on it, and hence would quickly burn out.

Ingenious Circuit Saves Money in Photoplay Houses

MOTION picture theatregoers demand that one film shall follow another without interruption. This has given rise to a troubling problem. Dissolving the beginning of one reel into the end of the preceding one, so that a continuous flow of the screen narrative is given, necessitates the use of two projecting machines, one of which is started just before the other stops. This maneuver requires two arcs burning at the same time, and two arcs, where alternating current only is available, means that



This circuit allows one rectifier to serve two motion picture projectors at the same time

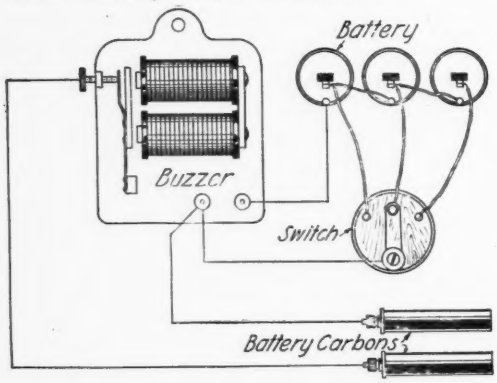
two alternating current rectifiers are necessary.

Motion picture operators in Philadelphia have solved the problem of supplying current to two arcs with one rectifier by the use of a four poled double throw switch connected as the accompanying diagram illustrates.

A Novel Medical Battery

A COMMON buzzer is used in place of the induction coil and connected with the dry cells through a multiple switch. The switch is of very simple construction. A piece of brass, cut in an L, with a battery binding post at one end, which serves as a pivot and terminal, and a knob at the other end to swing it about, compose the arm of the switch. Brass screws are best for contact points. The base may be made of a scrap of wood.

The L on the arm of the switch is a little less than the distance from the center of one screw to the center of the next. Therefore when the arm is moved it contacts with the approaching screw just before it leaves the receding one, and so all the way around. This eliminates the jerk when throwing another battery in the circuit.



A common electric buzzer is the only induction coil needed for this very simple medical battery

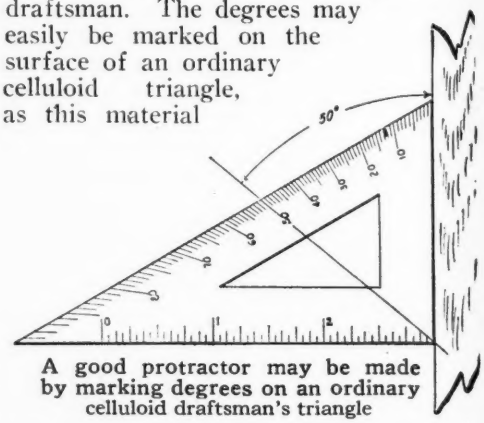
A wire is led from the contact screw and another from one of the binding posts of the buzzer. A round carbon from a battery is fastened to each one of these wires to provide handles through which the shock is given.

The first two batteries should be rather weak, so that persons not used to electricity may stand the shock. Any number of cells may be used, and by connecting each to a screw and to one another as shown in the drawing, the shocks may be varied from a slight vibration to a powerful shock.

All the batteries may be put in a box with a lid and the buzzer and switch mounted on top

A Combined Triangle and Protractor

THE combination of a triangle and protractor will prove a very useful addition to the implements of the draftsman. The degrees may easily be marked on the surface of an ordinary celluloid triangle, as this material



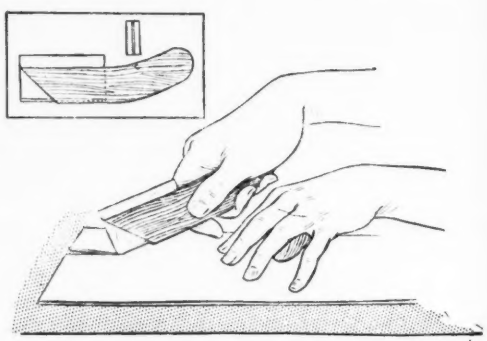
A good protractor may be made by marking degrees on an ordinary celluloid draftsman's triangle

is readily scratched with a sharp point. On the perpendicular of the triangle a scale may be marked, this further enhancing the value of the instrument. The degree markings may be placed in their proper positions with the aid of a protractor.

A Drawing Cutter

Make a handle similar to the one shown. Split it with a fine-toothed saw, in the end having the 45° angle sawed off, to a length about ½" longer than a safety razor blade. Make the opening fine, barely wider than a razor blade.

To use the cutter, place a safety razor blade in the slot, adjust it to the desired length by pushing forward or drawing backward, then hold by a pressure of the fingers on the sides of the handle.



A safety razor blade has many uses. This shows how a drawing cutter can be made out of a blade

Overhauling Your Car for the Winter

By Victor Pagé

(Continued from the December Number)

Valve Removal and Inspection

ONE of the most important parts of the gasoline engine and one that requires frequent inspection and refitting to keep in condition is the mushroom or poppet valve that controls the inlet and exhaust gas flow. In overhauling it is essential that these valves be removed from their seatings and examined carefully for various defects which will be enumerated at proper time. The valves are held against the seating in the cylinder by a coil spring which exerts its pressure on the cylinder casting at the upper end and against a suitable collar held by a key at the lower end of the valve stem. In order to remove the valve it is necessary to first compress the spring by raising the collar and pulling the retaining key out of the valve stem. Many forms of valve spring lifters have been designed to permit ready removal of the valves.

When the cylinder is of the valve in-the-head form, the method of valve removal will depend entirely upon the system of cylinder construction followed.

In the Franklin engine, which is shown in part section at Fig. 9, it is not possible to remove the valves without taking the cylinder off of the crank case, because the valve seats are machined directly in the cylinder head and the valve domes are cast integrally with the cylinder. This means that if the valves need grinding the cylinder must be removed

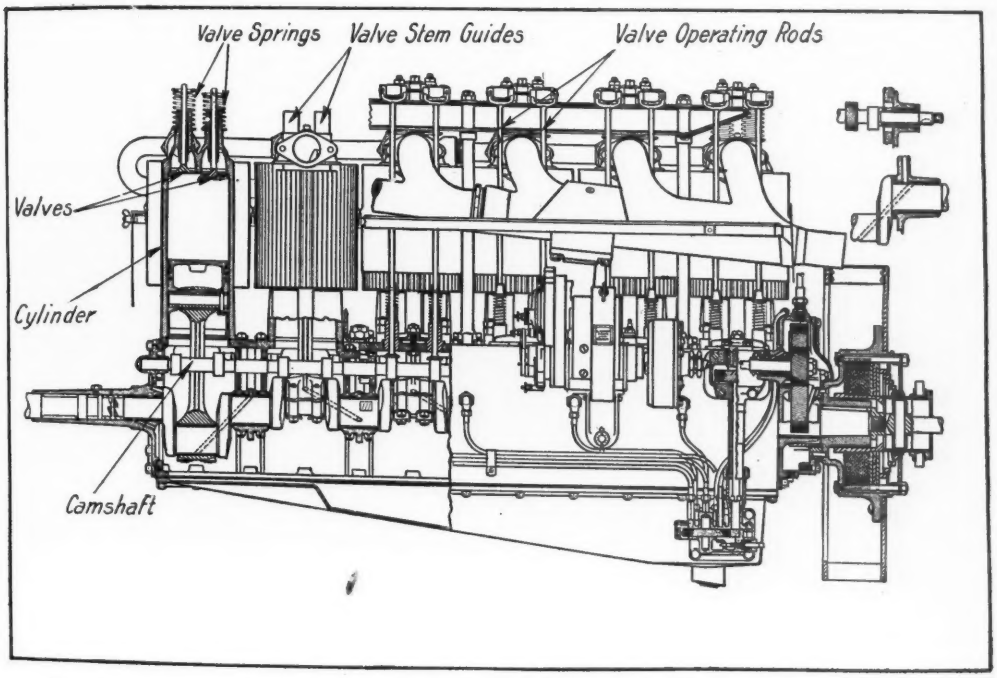


Fig. 9. A sectional view of part of the Franklin motor, showing valve seats machined directly in cylinder head, and valve domes cast integrally with the cylinder

from the engine base to provide access to the valve heads which are inside of that member, and which cannot be reached from the outside, as is true of the L or T-cylinder construction.

The preferred method of carrying the valves when they are placed in the cylinder head in the Buick 6-cylinder motor, is shown in Fig. 10. The valves are carried in cages which are readily removed from the cylinder head by unscrewing the retention nut that keeps the valve cage tightly pressed against the seating at its lower end to obtain a gas-tight joint. The valve cages are easy to handle and it is a relatively simple operation to compress the valve spring and remove the pin which makes for easy removal of the valve. When this construction is followed it is possible to grind in the valve by simply removing the cage assemblies from the cylinder. It is not necessary to disturb the cylinder in any way and does not call for disconnection of intake or exhaust manifolds; the only things that need be removed are the valve operating tappets, which is work of but a few moments.

Valve Grinding Process

Much has been said relative to valve grinding, and despite the mass of information given in the trade prints it is rather amusing to watch the average repairman or the motorist who prides himself on maintaining his own car performing this essential operation. The common mistakes are attempting to seat a badly grooved or pitted valve head on an equally bad seat, which is an almost hopeless job, and of using coarse emery and bearing down with all one's weight on the grinding tool with the hope of quickly wearing away the rough surfaces. The use of improper abrasive material is a fertile cause of failure to obtain a satisfactory seating. Valve grinding is not a difficult operation if certain precautions are taken before undertaking the work. The most important of these is to ascertain if the valve head or seat is badly scored or pitted. If such is found to be the cause no ordinary amount of grinding will serve to restore the surfaces. In this event the best thing to do is to remove the valve from its seating and to smooth down both the valve head and the seat in the cylinder before attempt is made to fit them together by grinding. Another important precaution is to make sure that the valve stem is straight, and that the head is not warped out of shape or loose on the stem when the valve is a two-piece member.

Valve Grinding Processes

Mention has been previously made of the importance of truing both valve head and seat before attempt is made to refit the parts by grinding. The appearance of a valve head when pitted or scored is indicated at Fig. 11, *A*, in order that the motorist or novice repairman can readily identify this defective condition. After smoothing the valve seat the next step is to find some way of turning the valve. Valve heads are usually provided with a screw driver slot passing through the boss at the top of the valve or with two drilled holes to take a forked grinding tool. The method of arranging the valve head for the grinding tool and the types of grinding tools commonly used are also shown at Fig. 11, *A*. A combination grinding tool which may be used when either the two drilled holes or the slotted head form of valve is to be rotated is shown at Fig. 11, *B*. This consists of a special form of screw driver having an enarged boss just above the blade, this boss serving to support a U-shaped piece which can be securely held in operative position by the clamp screw or which can be turned out of the way if the screw driver blade is to be used.

As it is desirable to turn the valve through a portion of a revolution and back again rather than turning it always in the same direction, a number of special tools has been designed to make this oscillating motion possible without trouble. A simple valve grinding tool is shown at Fig. 11, *C*. This consists of a screw driver blade mounted in a handle in such a way that the end may turn freely in the handle. A pinion is securely fastened to the screw driver blade shank, and is adapted to fit a rack provided with a wood handle and guided by a bent bearing member securely fastened to the screw driver handle. As the rack is pushed back and forth the pinion

must be turned first in one direction and then in the other.

A valve grinding tool patterned largely after a breast drill is shown at Fig. 11, *D*. This is worked in such a manner that a continuous rotation of the operating crank will result in an oscillating movement of the chuck carrying the screw driver blade. The bevel pinions which are used to turn the chuck are normally free unless clutched to the chuck stem by the sliding sleeve which must turn with the chuck stem and which carries clutching members at each end to engage similar members on the bevel pinions and lock these to the chuck stem, one at a time. The bevel gear carries a cam piece which moves the clutch sleeve back and forth as it revolves. This means that the pinion giving forward motion of the chuck is clutched to the chuck spindle for a portion of a revolution of the gear and clutch sleeve is moved back by the cam and clutched to the pinion giving a reverse motion of the chuck during the remainder of the main drive gear revolution.

A method that can be used for smoothing the surface of a valve head when the usual form of valve head truer is not available is indicated at Fig. 11, *E*. The valve heads are usually provided with a small depression in the center known as a countersink which is designed to act as a support for the valve when it is being machined from the forging. The stem of the valve is caught in the chuck of a bit stock and rested on any sharp point on a wall or bench. This can be easily made by driving a large wire nail in the bench from underneath so that the point projects through the bench. The bit stock is briskly turned by a helper and the rough spots are removed from the seat with a fine file, care being taken not to change the taper of the valve head. The valve stem could be turned much faster and a superior finish obtained if a breast drill were used instead of a bit stock, though with care a very creditable job may be done with the latter.

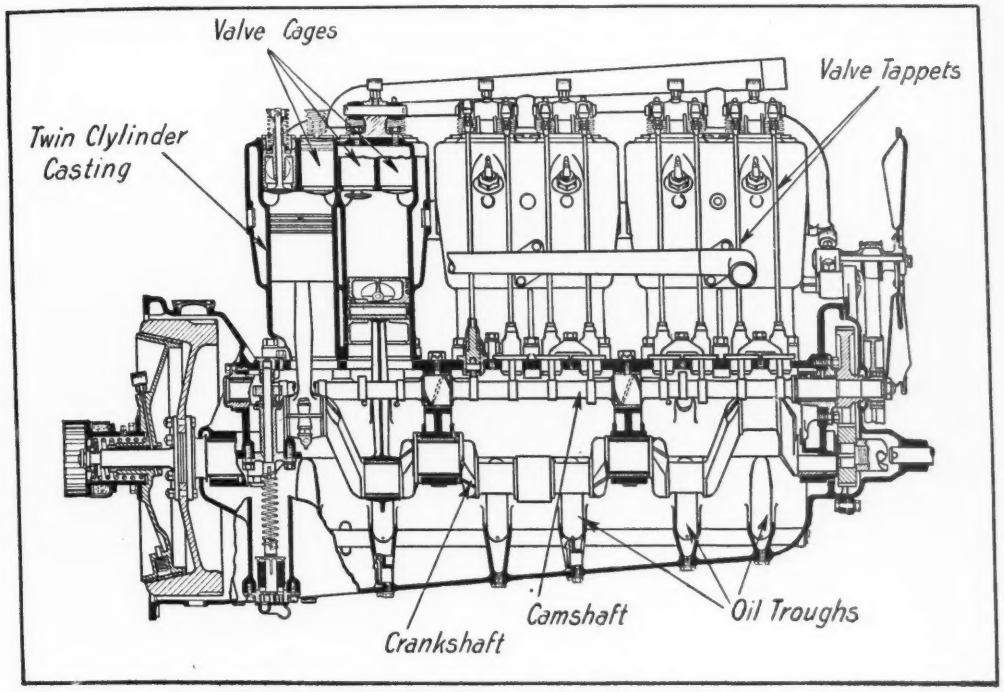


Fig. 10. A part sectional view of Buick Motor, showing method of valve mounting in easily removable valve cages

One of the things to watch for in valve grinding is clearly indicated at Fig. 11, *F*. It sometimes happens that the adjusting screw on the valve lift plunger or the valve lift plunger itself does not

permit the valve head to rest against the seat. While the condition is exaggerated in the sketch it will be apparent that unless a definite space exists between the end of the valve stem and the valve lift plunger that grinding will be of little avail because the valve head will not bear properly against the abrasive material smeared on the valve seat.

When a bit stock is used, instead of being given a true rotary motion the chuck is merely oscillated through the greater part of the circle and back again. It is necessary to lift the valve from its seat frequently as the grinding operation continues, this is to provide an even distribution of the abrasive material placed between the valve head and its seat. Only sufficient pressure is given to the bit stock to overcome the uplift of the spring and to insure that the valve will be held against the seat.

The abrasive generally used is a paste of medium or fine emery and lard, oil or kerosene. This is used until the surfaces are comparatively smooth, after which the final polish or finish is given with a paste of flour emery, grindstone dust, crocus or ground glass and oil. An erroneous impression prevails in some quarters that the valve head surface and the seating must have a mirror-like polish. While this is not necessary it is essential that the seat in the cylinder and the bevel surface of the head be smooth and free from pits or scratches at the completion of the operation. All traces of the emery and oil should be thoroughly washed out of the valve chamber with gasoline before the valve mechanism is assembled and in fact it is advisable to remove the old grinding compound at regular intervals, wash the seat thoroughly and supply fresh material as the process is in progress. The truth of seatings may be tested by taking some Prussian blue pigment and spreading a thin film of it over the valve seat. The valve is dropped in place and is given about one-eighth turn with a little pressure on the tool. If the seating is good both valve head and seat will be covered uniformly with color. If high spots exist, the heavy deposit of color will show these while the low spots will be made evident because of the lack of pigment. The grinding process should be continued until the test shows an even bearing of the valve head at all points of the cylinder seating.

Piston Troubles

If an engine has been entirely dismantled it is very easy to examine the pistons for deterioration. While it is important that the piston be a good fit in the cylinder it is mainly upon the piston rings that compression depends. The piston should fit the cylinder with but little looseness, the usual practice being to have the piston diameter at the point where the least heat is present or at the bottom of the piston. It is necessary to allow more than this at the top of the piston owing to its expansion due to the direct heat of the explosion. The clearance is usually graduated and a piston that would be .005-inch smaller than the cylinder bore at the bottom would be about .0065-inch at the middle and .0075-inch at the top. If much more play than this is evidenced the piston will "slap" in the cylinder and the piston will be worn at the ends more than in the center. Pistons sometimes warp out of shape and are not truly cylindrical. This results in the high spots rubbing on the cylinder while the low spots will be blackened where a certain amount of gas has leaked by.

Mention has been previously made of the necessity of reboring or regrinding a cylinder that has become scored or scratched and which allows the gas to leak by the piston rings. When the cylinder is ground out, it is necessary to use a larger piston to conform to the enlarged cylinder bore. Most manufacturers are prepared to furnish over-size pistons, there being four standard over-size dimensions adopted by the S. A. E. for rebored cylinders. These are .010-inch, .030-inch, and .040-inch larger than the regular dimensions. Care should be taken in reboring the cylinders to adhere as closely as possible to one or the other of these standards.

Removing Pistons Stuck in Combustion Chamber

The removal and replacement of pistons and rings seldom offer any trouble

if the work is properly carried on but if for any reason the piston should be pushed too far up into the cylinder on some types of engines the top ring will expand into the combustion chamber and will lock the pistons tightly in place. This is a difficult condition to overcome with some forms of cylinders though if the cylinder casting is of the *L* or *T* form it may be possible to compress the rings sufficiently to remove the piston by simple means. The best method is shown at Fig. 13, *A*. A very thin strip of metal of approximately the same width as the piston rings is passed through one of the valve chamber openings and passed around the piston and pulled out through the other opening. It requires the services of two people and sometimes three to remove a piston stuck in this manner. The efforts of one are directed to keep the band taut under the ring and to exert an upward pull which forces that portion of the ring embraced by the metal band to fill the groove in the piston. Another person uses a pair of screw drivers, one through each valve chamber opening to compress the ring at the points indicated in the drawing. This means that a three-point compressional effect is obtained and it is a simple matter for the third person to draw the piston back into the cylinder when the ring has been properly compressed in its groove. It is not always possible to compress the ring so the only other alternative is to break it in a number of pieces by hitting the brittle ring with a drift or chisel and then withdrawing the pieces one at a time until the ring has been entirely removed. With the T-head cylinder it is sometimes possible to remove the ring without the use of the metal bands, as that member is compressed at diametrically opposite points by a screw driver inserted through each valve chamber cap.

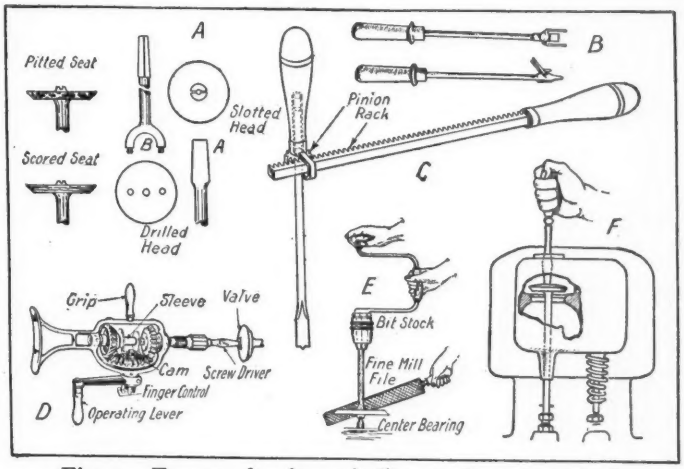


Fig. 11. Forms of valve grinding tools and methods of grinding

Fitting Piston Rings

Before installing new rings, they should be carefully fitted to the grooves to which they are applied. The tools required are a large piece of fine emery cloth, a thin, flat file, a small vise with copper or leaden jaw clips, and a smooth hard surface such as that afforded by the top of a surface plate or a well-planed piece of hard wood. After making sure that all deposits of burnt oil and carbon have been removed from the piston grooves, three rings are selected, one for each groove. The ring is turned all around its circumference into the groove it is to fit, which can be done without springing it over the piston as the outside edge of the ring may be used to test the width of the groove just as well as the inside edge. The ring should be a fair fit and while free to move circumferentially there should be no appreciable up and down motion.

The ring should be pushed into the cylinder at least two inches up from the bottom and endeavor should be made to have the lower edge of the ring parallel with the bottom of the cylinder. If the ring is not of correct diameter, but is slightly larger than the cylinder bore, this condition will be evident by the angular slots of the rings being out of line or by difficulty in inserting the ring if it is a

lap joint form. If such is the case the ring is removed from the cylinder and placed in the vise between the soft metal jaw clips, as shown at Fig. 13 *B*. Sufficient metal is removed with a fine file from the edges of the ring at the slot until the edges come into line and a slight space exists between them when the ring is placed into the cylinder. It is important that this space be left between the ends, for if this is not done, when the ring becomes heated the expansion of metal may cause the ends to abut and the ring to jam in the cylinder.

Fig. 12. A nail or piece of wire will grind Buick valves

Another method of fitting a piston ring is indicated at Fig. 13, *C*. A plug is made of soft wood, such as yellow pine that will be an easy fit in the cylinder and one end is turned down enough so that a shoulder will be formed to back the ring. The turned down portion should be a little less than the width of the ring to be tested. The ring is pushed on this turned down end of the wooden plug and held by a small batten secured by a screw in the center. This does not hold the ring tightly enough to keep it from closing up. It is also important to turn the end of the wooden plug small enough so that its diameter will be less than the bore of the ring when that member is tightly closed. The cylinder bore is smeared with a little Prussian blue pigment which is spread evenly over the cylinder wall with a piece of waste and the ring is moved back and forth in the cylinder while it is held square by the shoulder on the plug. The high spot on the ring will be shown by color. Usually the ring will be found to bear hardest at each side of the slot. These high spots are removed carefully with a very fine mill file or piece of emery cloth and the ring is again inserted in the cylinder bore to find other high spots which are removed in a similar manner. When the rings fit fairly well all around, the entire surface will have a uniform coating of blue.

If the old piston rings are bright all around but appear to have lost their elasticity, a new lease of life may be given by a process known as peening, which is shown at Fig. 13, *D*. The ring is stood on a surface plate and is tapped inside with the peen end of a light hammer using the harder blows at the thick section and gradually reducing the force of the blow as the slot is approached. If skillfully done a ring may be stretched to some extent and considerable elasticity imparted. Piston rings are not always of simple form shown. Various duplex constructions have been offered with an idea of reducing the possibility of leakage. A ring of this type which is known as the "Leak Proof" piston packing is shown at Fig. 13, *E*. These duplex rings are harder to install than the simple forms, and it is important that they be carefully fitted to the cylinder and to the piston grooves, as described below.

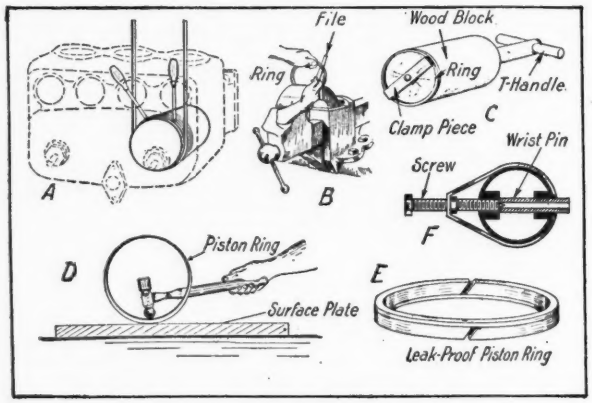


Fig. 13. Processes incidental to piston ring restoration

The bottom ring should be placed in position first; this is easily accomplished by springing the ring open enough to pass on the piston and then sliding it into place in the lower groove which on some types of engines is below the wrist pin, whereas in others all grooves are above that member. It is

not always necessary to use guiding strips of metal when replacing rings as it is often possible, by putting the rings on the piston a little askew and manœuvering them to pass the grooves without springing the ring into them. The top ring should be the last one placed in position.

Before replacing pistons in the cylinder one should make sure that the slots in the piston rings are spaced equidistant on the piston and if pins are used to keep the ring from turning one should be careful to make sure that these pins fit into their holes in the ring and that they are

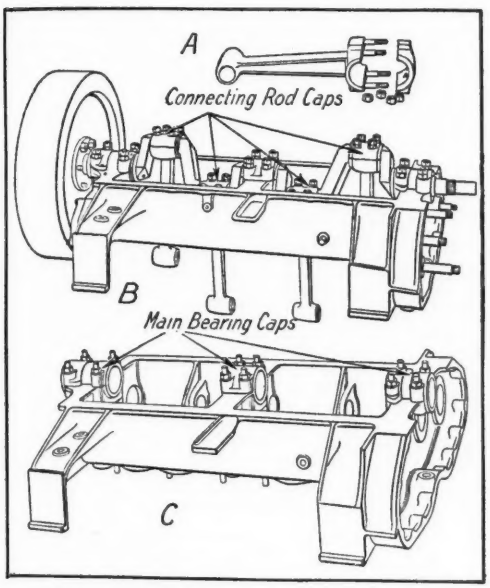


Fig. 14. Showing method of supporting crankcase to provide ready access to connecting rod and crankshaft bearings

not under the ring at any point. The cylinder should be well oiled before attempt is made to install the pistons. The engine should be run with more than the ordinary amount of lubricant for several days after new piston rings have been inserted.

Inspection and Refitting of Engine Bearings

While the engine is dismantled one has an excellent opportunity to examine the various bearing points in the engine crankcase to ascertain if any looseness exists due to depreciation of the bearing surfaces. As will be evident from the views at Figs. 14 and 15, both main crankshaft bearings and the lower end of the connecting rods may be easily examined for deterioration. With the rods in place as shown at Fig. 14, *A*, it is not difficult to feel the amount of lost motion by grasping the connecting rod firmly with the hand and moving it up and down.

The appearance of the engine base after the connecting rods and flywheel have been removed from the crankshaft is shown at Fig. 15, while the appearance of the upper portion of the crankcase, after the crankshaft is removed is clearly shown at Fig. 14, *C*.

After the connecting rods have been removed and the flywheel taken off the crankshaft to permit of ready handling any looseness in the main bearing may be detected by lifting upon either the front or rear end of the crankshaft and observing if there is any lost motion between the shaft journal and the main bearing caps. It is not necessary to take an engine entirely apart to examine the main bearings as in some forms these may be readily reached by removing a large inspection plate either from the bottom or side of the engine crankcase. The symptoms of worn main bearings are not hard to identify. If an engine knocks when a vehicle is traveling over level roads regardless of speed or spark lever position and the trouble is not due to carbon deposits in the combustion chamber one may reasonably surmise that the main bearings have become loose or that lost motion may exist at the connecting rod big ends, and possibly at the wrist pins.

Adjusting Main Bearings

When the bearings are not worn enough to require refitting the lost motion can often be eliminated by removing one or more of the thin shims or liners ordinarily used to separate the bearing caps from the seat. Care must be taken that an even number of shims of the same thickness are removed from each side of the journal. If there is considerable lost motion after one or two shims have been removed, it will be advisable to take out more shims and to

scrape the bearing to a fit before the bearing cap is tightened up. It may be necessary to clean up the crankshaft journals as these may be scored due to not having received clean oil or having had bearings seize upon them. It is not difficult to true up the crank pins or main journals if the score marks are not deep. A fine file and emery cloth may be used, or a lapping tool. The latter is preferable because the file and emery cloth will only tend to smooth the surface while the lap will have the effect of restoring the crank to proper contour.

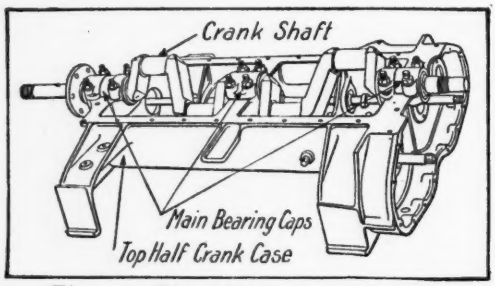


Fig. 15. Top half of crankcase, showing method of crankshaft retention by three main bearing caps

If a crank pin is worn out of true to any extent the only method of restoring it is to have it ground down to proper circular form by a competent mechanic having the necessary machine tools to carry on the work accurately.

After the crankshaft is trued the next operation is to fit it to the main bearings or rather to scrape these members to fit the shaft journal. In order to bring the brasses closer together, it may be necessary to remove a little metal from the edges of the caps to compensate for the lost motion. A piece of medium emery cloth is rested on the surface plate and the box or brass is pushed back and forth over that member by hand, the amount of pressure and rapidity of movement being determined by the amount of metal it is necessary to remove. This is better than filing because the edges will be flat and there will be no tendency for the bearing caps to rock when placed against the bearing seat. It is important to take enough off the edges of the boxes to insure that they will grip the crank tightly. The outer diameter must be checked with a pair of calipers during this operation to make sure that the surfaces remain parallel. Otherwise the bearing brasses will only grip at one end and with such insufficient support they will quickly work loose, both in the bearing seat and bearing cap.

Scraping Brasses to Fit

To insure that the bearing brasses will be a good fit on the trued up crank pins or crankshaft journals they must be scraped to fit the various crankshaft journals. The process of scraping, while a tedious one, is not difficult, requiring only patience and some degree of care to do a good job. The surface of the crank pin is smeared with Prussian blue pigment which is spread evenly over the entire surface. The bearings are then clamped together in the usual manner with the proper bolts and the crankshaft revolved several times to indicate the high spots on the bearing cap. The high spots are indicated by blue, as where the shaft does not bear on the bearing there is no color. The high spots are removed by means of a scraping tool, which is easily made from a worn out file. These are forged to shape and ground hollow and are kept properly sharpened by frequent rubbing on an ordinary oil stone. To scrape properly, the edge of the scraper must be very keen.

When correcting errors on flat or curved surfaces by hand scraping, it is desirable, of course, to obtain an evenly spotted bearing with as little scraping as possible. When the part to be scraped is first applied to the surface-late or to a journal in the case of a bearing three or four "high" spots may be indicated by the marking material. The time required to reduce these high spots and obtain a bearing that is distributed over the entire surface depends largely upon the way the scraping is started. If the first bearing marks indicate a decided rise in the surface, much time can be saved by scraping larger areas than are covered by the bearing marks; this is especially true of large shaft and engine bearings, etc. An experienced workman will not only remove the heavy marks, but also reduce a larger area; then, when the bearing is tested again, the marks

will generally be distributed somewhat. If the heavy marks which usually appear at first are simply removed by light scraping, these "point bearings" are generally enlarged, but a much longer time will be required to distribute them.

The number of times the bearing must be applied to the journal for testing is important, especially when the box or bearing is large and not easily handled. The time required to distribute the bearing marks evenly depends largely upon one's judgment in "reading" these marks. In the early stages of the scraping operation, the marks should be used partly as a guide for showing the high areas, and instead of merely scraping the marked spot the surface surrounding it should also be reduced, unless it is evident that the unevenness is local. The idea should be to obtain first a few large but generally distributed marks; then an evenly and finely spotted surface can be produced quite easily.

In fitting brasses when these are of the removable type, two methods may be used. The upper half of the engine base may be inverted on a suitable bench or stand and the boxes fitted by placing the crankshaft in position, clamping down one bearing cap at a time and fitting each bearing in succession until they bed equally. From that time on the bearings should be fitted at the same time so the shaft will be parallel with the bottom of the cylinders. Considerable time and handling of the heavy crankshaft may be saved if a preliminary fitting of the bearing brasses is made by clamping them together with a carpenter's wood clamp and leaving the crankshaft attached to the bench. The brasses are revolved around the crankshaft journal and are scraped to fit wherever high spots are indicated until they assume a finished appearance. The final scraping should be carried on with all bearings in place and revolving the crankshaft to determine the area of the seating. When the brasses are properly fitted they will not only show a full bearing surface but the shaft will not turn unduly hard if revolved with the same amount of leverage as afforded by the flywheel rim or starting crank, bearing caps being bedded down and lubricated.

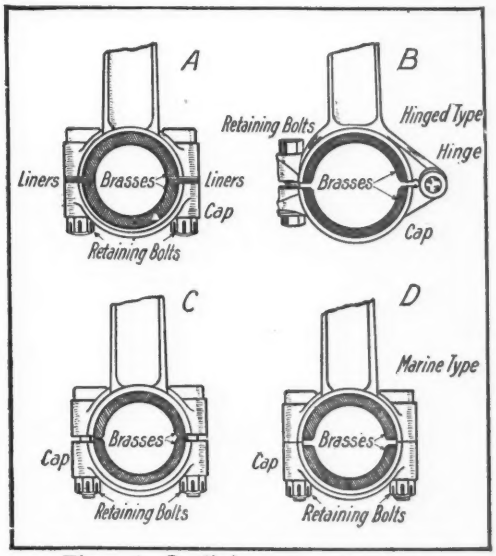


Fig. 16. Outlining common types of connecting rod big ends

Bearings of white metal or babbitt can be fitted tighter than those of bronze and care must be observed in supplying lubricant as considerably more than the usual amount is needed until the bearings are run in by several hundred miles of road work. Before the scraping process is started it is well to chisel an oil groove in the bearing as these grooves are very helpful in insuring uniform distribution of oil over the entire width of bearing and at the same time act as reservoirs to retain a supply of oil. The tool used is a round nosed chisel, the effort being made to cut the grooves of uniform depth and having smooth sides. Care should be taken not to cut the grooves too deeply as this will seriously reduce the strength of the bearing bushing.

Remetalling and Fitting the Connecting Rods

Fitting and adjusting the rod bearings, especially those at the crank pin end, is one of the operations that must be performed several times a season if a car is used to any extent. There are two forms of connecting rods in general use, known respectively as the marine type, shown at Fig. 16, *A*, and the hinged form depicted at Fig. 16, *B*. The hinge type is the simplest, but one clamp bolt being used to keep the parts together as the cap is hinged to the rod

end on one side, this permitting the lower portion to swing down the crank pin to pass out from between the halves when the retaining bolt is removed. In the marine type, which is the most common, one or two bolts are employed at each side and the cap must be removed entirely before the bearing can be taken off of the crank pin. The tightness of the brasses around the crank pin can never be determined solely by the adjustment of the bolts, as while it is important that these should be drawn up as tightly as possible the bearing should fit the shaft without undue binding, even if the brasses must be scraped to insure a proper fit. As is true of the main bearings, the marine form of connecting rod has a number of liners or shims interposed between the top and lower portions of the rod end and these may be reduced in number when necessary to bring the brasses closer together.

In fitting new brasses there are two conditions to be avoided, these being outlined at Fig. 16, *C* and *D*. In the case shown at *C* the light edges of the brushings are in contact, but the connecting rod and its cap do not meet. When the retaining nuts are tightened the entire strain is taken on the comparatively small area of the edges of the bushings which are not strong enough to withstand the strains existing and which flatten out quickly, permitting the bearing to run loose. In the example outlined at *D* the edges of the brasses do not touch when the connecting rod cap is drawn in place. This is not good practice, because the brasses soon become loose in their retaining member. In the case outlined it is necessary to file off the faces of the rod and cap until these meet, and to insure contact of the edges of the brasses as well. In event of the brasses coming together before the cap and rod make contact, as shown at *C*, the bearing halves should be reduced at the edges until both the caps and brasses meet against the surfaces of the liners as shown at *A*.

Before assembling on the shaft, it is necessary to fit the bearings by scraping, the same instructions given for restoring the contour of the main bearings applying just as well in this case. It is apparent that if the crank pins are not round no amount of scraping will insure a true bearing. A point to observe is to make sure that the heads of the bolts are imbedded solidly in their proper position and that they are not raised by any burrs or particles of dirt under the head which will flatten out after the engine has been run for a time and allow the bolts to slack off. Similarly, care should be taken that there is no foreign matter under the brasses and the box in which they seat. To guard against this the bolts should be struck with a hammer several times after they are tightened up, and the connecting rod can be hit sharply several times under the cap with a wooden mallet or lead hammer. It is important to pin the brasses in place to prevent movement, as lubrication may be interfered with if the bushing turns round and breaks the correct register between the oil hole in the cap and brasses.

Care should be taken in screwing on the retaining nuts to insure that they will remain in place and not slack off. Spring washers should not be used on either connecting rod ends or main bearing bolts, because these sometimes snap in two pieces and leave the nut slack. The best method of locking is to use well-fitting split pins and castellated nuts. In a number of the cheaper cars, the bearing metal is cast in place in the connecting rod lower end and in main bearings, and is not in the form of removable die cast bushings.

Precautions in Reassembling Parts

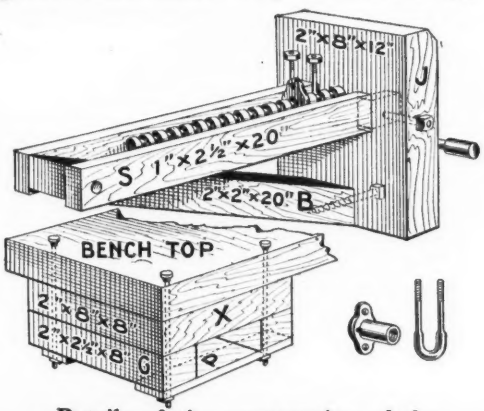
When all of the essential components of a power plant have been carefully looked over and cleaned and all defects eliminated, either by adjustment or replacement of worn portions, the motor should be reassembled, taking care to have the parts occupy just the same relative positions they did before the motor was dismantled.

Before the cylinders are replaced on the engine base, heavy brown paper gaskets should be made to place between the cylinder base flange and top portion of the engine crank case. Gaskets will hold better if coated with shellac, as it fills irregularities in the joint and assists materially in preventing leakage after the coating has a chance to set.

To Make a Work Bench and Vise

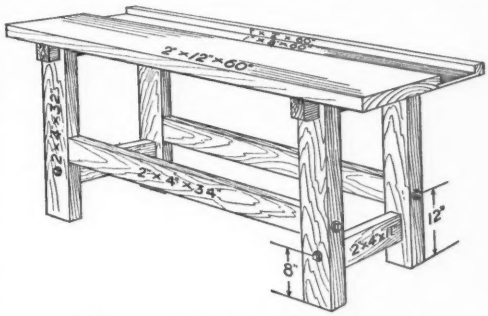
THERE is nothing more essential to good work than a good bench. When room was plentiful and lumber cheap it was the usual practice to construct large, heavy benches. With the spread of the manual training idea a rather new and different type of bench has been developed. They are smaller, and a type of construction is used which will require a minimum amount of lumber to give the required strength and rigidity. In the bench shown the two top rails are notched into the legs, while all of the lower rails are first cut square on each end and drawn and held in position against the legs by means of the bolts. To do this the holes are first located and bored in the legs the size of the bolts or 1/16″ larger. Next, the same sized hole is bored into the end of the rail to a depth of 4″. From the side a 1″ hole is bored in to meet the end of this one. The center of this hole should be located 3½″ from the end of the rails. In assembling, the nut is placed in the rail from the side and the bolt through the leg and into the end of the rail to meet it, when the bolt may be drawn tight by means of a wrench applied to the head. The bench may be kept rigid indefinitely by going over all of the bolts occasionally.

The top of the bench may be one or several pieces glued together. The latter method is the better as well as the most usual one, but is not essential to a good bench. The back pieces are easily worked out to the size suggested. Any good, sound lumber may be used for the bench, though hard lumber, such as oak or maple, is best. The last mentioned is most often used.



Details of the construction of the vise, showing dimensions

The bench described above may be fitted up with a machinist's, cabinet maker's, pattern maker's or any other type of vise the builder may desire. A very satisfactory form for general wood work is shown here. The greatest advantage of the parallel jaw vise is the fact that at all times it will take firm hold on the work without injuring it or causing it to pop out as soon as work is begun.

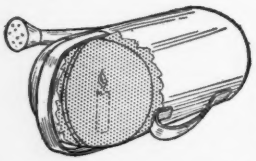


The completed work bench, without the vise, showing dimensions and general construction

The upper part of the vise, as shown in the sketch, or the front jaw, is first worked up, after which the guides shown under the bench top are worked out and assembled. Care should be used to secure a snug fit, but no binding should be allowed. The edge of the bench top, together with the piece marked X, forms the back jaw. Both back and front jaws should have wood faces supplied them to take the wear. These are easily replaced. They are not shown in the drawing. The part *P* is best an iron plate, although wood will serve; ¼″ x 1″ x 12″ is the size. The iron washer is cut from the same size stock. The ends support the back of the slide marked *S*. They should project ¾″ from *G*. Carriage bolts are used to bolt the guides together and to the bench top.

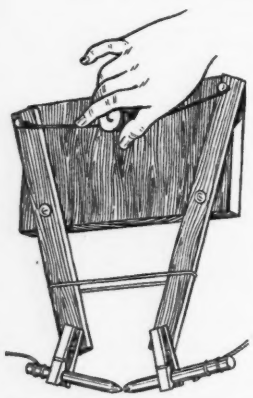
The screw is of the usual form and manner. The nut, however, is not fastened as usually, but instead is bolted to the underside of *X* by means of the clamp shown. The satisfaction this bench and vise will afford will quickly repay the builder for all time and expense required to make them.

A Sprinkling Can as a Dark Room Lamp



AN example of how a common utensil can be converted to a purpose other than the one for which it was originally intended is shown in the illustration. A night light or a candle is placed inside a sprinkling can set on its side, and the semi-oval opening which receives the water is covered with a few folds of ruby tissue paper affixed with music tape or glued tags. In this simple way, a very serviceable dark room lamp is obtained. Ventilation is provided for through the nozzle; the bend prevents the escape of light.

An Adjustable Arc Lamp



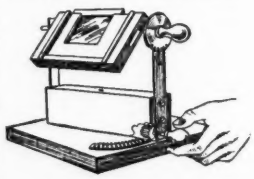
WOODEN arms are pivoted to the wood support by a screw and washer. The upper ends of the arms are drawn together by a rubber band passed around them. The carbons are clamped in spring clothes pins, which, being fastened to the arms with one screw only, allows them to be swung up or down. By this means the carbons may be adjusted at any angle to each other.

A spool is fastened at the lower part of the wood support with a long screw and washer. Two pieces of string are tied to opposite ends of the spool, given a few turns around it in the same direction, and fastened to tacks at the ends of the arms. The spool is fastened with just enough tension so that it will stay in place no matter which way it may be turned in adjusting the distance between the carbons.

Two pieces of spring brass wire are made into coils somewhat smaller than the carbons. These are sprung on the ends of the carbons, making good contact with them. The wires carrying the current are connected directly with these brass wires. Pieces of sheet fiber fitted in the jaws of the clothes pin clamps afford additional insulation, although the wood parts, if dry, are quite sufficient insulation for low voltages.

With an 110 volt house-lighting current, the lamp should be run in series with suitable lamp bank or other resistance. If the current is alternating, a choke coil may be used in series with it.

Adjustable Printing-Frame Holder



PHOTOGRAPHERS are often required to print a negative more deeply at one end than at another; but the ordinary method of holding the frame in the hand is unsteady and unreliable. An adjustable support for a printing-frame, enabling the operator to set one end further from the light than the other, is shown in the sketch. It consists of a wooden base upon which is supported and pivoted a block fitted with two uprights. With the aid of a ratchet and swivel indicated, the block may be moved to various positions. The two uprights are also furnished with a ratchet and screw, which grasp the printing-frame in the two trough-shaped groups provided in the latter. Various sized printing-frames may be inserted in this holder, and with the aid of the ratchets, the distances from the light to different portions of the negative may be easily adjusted.

Alcohol Burner

AN excellent alcohol burner can be made from an oil can with the spout cut off about an inch above the body, and a wick inserted. The flame can be raised by picking with a pin or any other sharp pointed instrument.

How to Build an Ice-Boat

THE ice-boat described is fast for its size, and can be built at a small cost. It has a sail area of about 70 sq. ft.—enough to carry two people. Good lumber should be used, such as bass wood or white pine, and the weight should be kept as low as possible.

The sail is of the "balanced" type. The dimensions are: Boom, or bottom, 10′; gaff, or top, 6′; leach, or back, 12′; and luff, or front, 7′. This sail can be

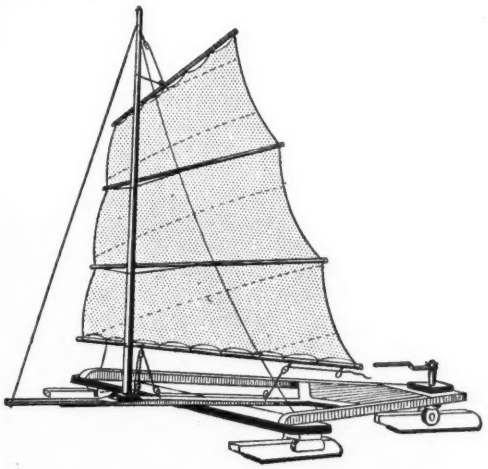


Fig. 1. The completed ice-boat, showing details of the sail

drawn tight by means of the rope and pulley on the boom as shown is Fig. 3. The flatter a sail hangs, the closer the boat will sail into the wind, for which reason two bamboo poles are put across the sail as shown in Fig. 1. A set of reef points should be fastened to the lower bamboo pole so the sail area can be decreased in case of a strong wind.

In making the sail, first chalk its outline on the floor, cut and sew the strips as shown in Fig. 1. The outer edge should be turned over and a cord sewn in. The top of the sail is not straight but is cut with a slight curve. Lace the sail to the poles with a strong cord.

The mast is 14′ high. Care should be taken to select straight-grained wood for the mast. At one-fourth of the distance from the top, the mast should be 3″ in diameter and taper to 2½″ at top and bottom. The bottom should rest on a hardwood block with a 2½″ hole drilled into it. Drill this hole 1½″ deep and fasten the block securely to the bowsprit 1½′ in front of the center of the runner plank.

The mast is held in place by three wire stays. On the two side stays, turnbuckles should be used to tighten the wires. Fasten a 3½″ ring to the boom with rawhide to hold the boom in place on the mast.

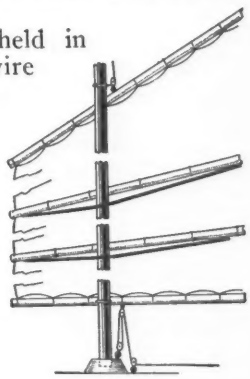


Fig. 3. Mast Rigging

Tie the top ring to the end of the rope, with which the sail is hoisted and thread the rope through the pulley on the center of the gaff, Fig. 3. A strong rope should be fastened as shown in Fig. 3. Do not make the sail poles until the sail is completed, and then make them 6″ or 8″ longer than the sail so stretching can be taken up. For drawing the sail in and out, fasten the rope and pulleys as shown in Fig. 1.

The runners and runner guides are made of oak. Cut runners as shown in Fig. 4, and fit iron shoes to them. For runner shoes use ¾″ square iron rod and flatten both ends so that holes can be drilled for bolts, to fasten to runners.

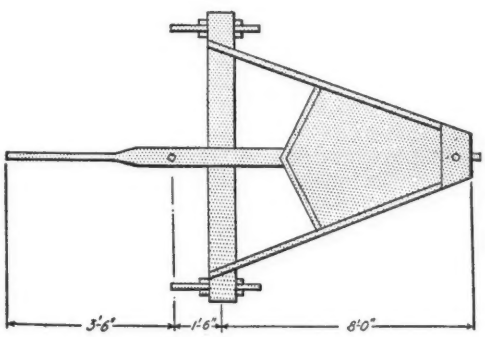


Fig. 2. Showing construction of the runner plank

The runner irons are not perfectly flat on the bearing edge, but have about ⅛" rocker curve. Fig. 5 shows how the runners are pivoted on the riding bolt. The top of the rudder post is square. Drill a small hole at top of the rudder

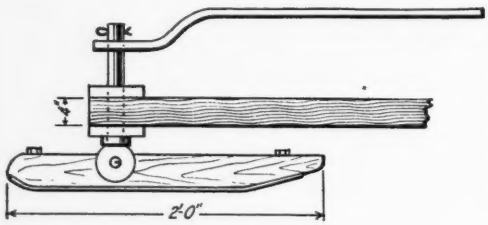


Fig. 4. Construction of the runners

post for a cotter pin so that the tiller will not slip off while sailing. A good rudder post can be made from an old bicycle fork. Put an iron plate and washers under the boat so the rudder will turn easily.

For the runner plank use a 2" x 8" plank 8' long. The side braces are 2" x 4" and the bowsprit is a 2" x 6" reenforced by a 1" board on each side, Fig. 2. The cockpit is 5' long and for the flooring use 1" matched boards. Give all woodwork a few coats of paint.

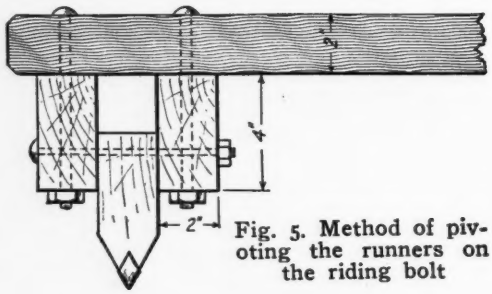


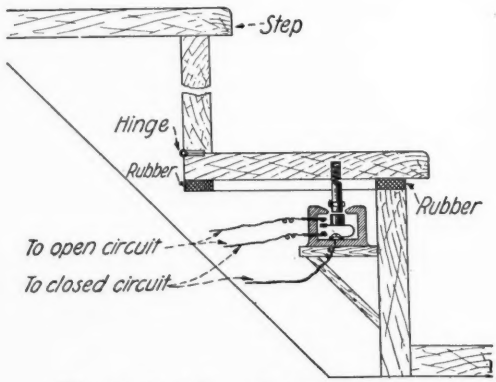
Fig. 5. Method of pivoting the runners on the riding bolt

How to Draw an Ellipse

DRAW the major and minor axes. With a radius equal to one-half of the major axis from the extremity the minor axis describe an arc cutting the major axis. At the two points where the major axis is cut, place tacks or pins. Then place the pencil on the end of either axis and pass a thread around the point of it and the two tacks. Draw the thread tight and tie it. Describe the eclipse. If it is desired to use ink a pen is substituted for the pencil.

A Doorstep Burglar Alarm

AN alarm ringing arrangement which will announce the intrusion of undesirable visitors can be installed on a door step, and be completely concealed. One of the steps is removed and replaced with a hinge at the back. Beneath the step a spring contact is placed and connected with batteries and a bell. A rubber cushion is tacked along the edge of the board upon which the step rests. The weight of the body on the step will press the contacts together, closing the circuit. The resiliency of the rubber cushion will press the step back in place when the weight is removed.



The contact is made and the alarm bell rung by the pressure of any weight, even that of a child

A Simple Laboratory Burner

A GOOD burner for the laboratory which can be easily constructed is shown in the sketch, which is self-explanatory. The standard was made from ⅜" pipe fittings, and the valve was obtained from an old kitchen gas range.

Waterproofing Shoes

THE soles of shoes or boots may be made waterproof, and also made to wear much longer, by giving them three coats of varnish, allowing each coat to soak into the leather well before applying another.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication

Impedance of Oscillation Circuits in Wireless Telegraphy

By John Vincent

IN last month's article it was shown that every antenna had a particular natural wave-length, or fundamental wavelength, which it would radiate if it were excited electrically and then left to oscillate. It was pointed out that this natural wavelength depended upon the capacity and inductance of the aerial, and that these in turn depended upon the total length of the antenna-to-ground system. It was also shown that if inductance were added in series with the antenna, so as to "load" the system electrically, the resonant wavelength would be increased. A simple rule for computing arithmetically the resonant radiant wavelength in meters, when the capacity in microfarads and the inductance in millihenrys is known, was stated.

It should be noted especially that the wavelength radiated depends upon the size of the capacity and inductance coils in the circuit. The reason for this is that the length of radiated wave depends upon its frequency, or the number of times in one second the electromagnetic field passes through a complete cycle of change in direction. This wave-frequency must be the same as the frequency of the oscillating current in the antenna system, which produces it, and the oscillation frequency is determined by the amount of capacity and inductance in the antenna circuit.

Considering ether-waves of the sort used in radio-telegraphy, which pass over the surface of the earth from the sender to receivers in any direction at a speed of 186,000 miles per second, the usual relation between velocity, wavelength and wave-frequency may be used. In these waves, as in any other traveling waves, the frequency is found by dividing the velocity by the wavelength.

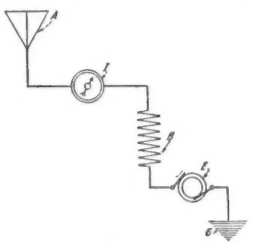


Fig. 1

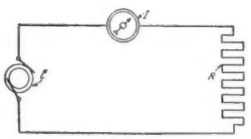


Fig. 2

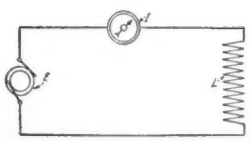


Fig. 3

A wavelength of 2,000 meters has, therefore, a wave-frequency of 150,000 per second, since the velocity in meters per second (300,000,000) divided by the length (2,000 meters) gives this figure. Thus, to find the frequency per second of any wavelength in radio, divide three hundred million by the wavelength in meters. Similarly, to find the wavelength in meters for any frequency, divide the frequency per second into 300,000,000, which goes:

WAVELENGTH *Meters*	FREQUENCY *Cycles per second*
300	1,000,000
600	500,000
1,000	300,000
2,000	150,000
3,000	100,000

These frequency values are not only the numbers of cycles per second in the radio waves, but also the frequencies of the oscillating currents which will set up such waves. Referring to Figure 1, if E represents a radio frequency alternator which generates current of 100,000 cycles per second in the antenna-to-ground circuit A, I, B, E, G, the system will radiate waves corresponding to that frequency, or 3,000 meters in length. The stronger the 100,000 cycle current in the antenna, the more powerful will be the radiated waves. It is therefore desirable to do anything possible to increase this antenna current. Also, the higher the antenna the more powerful will be the radiation of waves for a given current. It is for this reason that great heights are sought in erecting sending antennas.

When a battery or direct current generator applies a voltage or electrical pressure across the terminals of a circuit having resistance, an electric current flows through that circuit. The strength of the current is fixed by the amounts of voltage and resistance, and, measured in amperes, equals the number of volts pressure divided by the number of ohms resistance. This is simply Ohm's Law in its elementary form, and the fact is one of the first things learned in the study of electricity. But its extension to alternating current circuits is not so well understood, though it is very little more complicated. In fact, the same law in the same form applies to alternating currents, if one uses instead of the simple ohmic resistance its alternating current equivalent, or impedance.

Impedance, or effective alternating-current resistance, is the property of circuits which determines how much current will flow when a certain alternating voltage is applied. The current in amperes is always equal to the applied electro-motive force in volts divided by the *impedance* in ohms. If, in Figure 1, the alternator E generates 100,000 cycles and 100 volts, and if the total impedance of the antenna-to-ground circuit is 5 ohms for this frequency, a radio-frequency current of 20 amperes will flow through the ammeter I, and waves of corresponding intensity will be radiated. If the impedance were 10 ohms, only 10 amperes would flow and the waves would be very much weaker. Evidently for powerful sending the antenna circuit impedance must be kept as small as possible, since then the current is largest.

How can the impedance be made small? Before this question can be answered it is necessary to find out what impedance really is, and whether it is always the same for any particular circuit.

Four quantities enter into the makeup of impedance, and these are the resistance, capacity and inductance of the circuit, and the frequency of the current flowing in it. That portion which depends upon the capacity and inductance of the circuit is called the reactance, and changes as the frequency changes. This reactance is always added by a special rule to the simple resistance to make up the total impedance. The resistance itself remains practically constant for reasonably small changes of frequency, but the reactance may vary greatly if the frequency is changed even slightly. The effort to increase antenna current by making impedance as small as possible must therefore be confined almost entirely to reducing the *reactance* portion, since the simple resistance of coils, wires and earth connection is always reduced to the smallest feasible amount to begin with.

The computation of reactance in alternating current circuits is not complicated, and may be considered in two parts. Referring to Fig. 2, a resistance R is seen in series with an alternator E and ammeter I. Since reactance depends upon the presence of inductance or capacity, and since the circuit of Fig. 1 has no inductance or capacity, there is zero reactance. The impedance is therefore made up of the resistance R only, and the current I is found, in amperes, by dividing the resistance in ohms (which in this case equals the impedance in

ohms) into the alternator electromotive force in volts. This is true for any frequency, except for comparatively small changes in the resistance.

If instead of the resistance there is connected a coil having inductance, L in Fig. 3, a very different condition holds. This circuit possesses inductive reactance of an amount in ohms equal to 6.28 times the frequency of the current times the inductance of the coil in henrys. If the alternator frequency is 100,000 per second and the coil has 5 millihenrys (or 5/1000 of a henry) inductance, the inductive reactance is 6.28 times 100,000 times 5/1000, or 3140 ohms. Assuming the resistance to be zero, if the alternator produces 100 volts, only 100/3140 or 0.0318 of an ampere will flow. Thus for this frequency the simple coil of wire presents more effective resistance than would a straight carbon rod of 3,000 ohms. It should be noted that the higher the frequency goes the greater becomes the reactance, and therefore the impedance, of a coil. At zero frequency, which is direct current, the reactance vanishes and the impedance of the coil is merely its resistance.

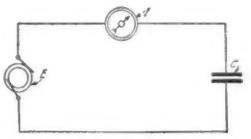


Fig. 4

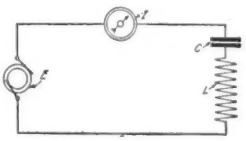


Fig. 5

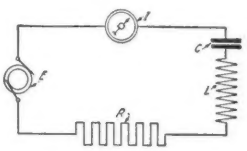


Fig. 6

Still another condition holds if a condenser is connected in the circuit, as in Fig. 4. The circuit now has what is called capacity reactance, and this, in ohms, amounts to the reciprocal of 6.28 times the frequency times the capacity in farads. If the frequency is 100,000 per second and the capacity is 0.0005 microfarad (or 5/10,000,000,000 farad), the capacity reactance figures out 6.28 times 100,000 times 5/10,000,000,000 divided into 1, or 0.000314 divided into 1, or 3,180 ohms. This would permit about one-thirtieth of an ampere to flow if 100 volts at 100,000 cycles were applied. The most important thing to note as to capacity reactance is that it *decreases* as the size of the condenser increases, and as the applied frequency increases. It is in effect an exact opposite of inductive reactance, and each *may be used to neutralize the current limiting characteristic of the other.*

This opposition of capacity and inductance reactances is one of the most important phenomena made use of in radio telegraphy, and is the basis of resonance. The action may be illustrated by studying Figure 5, where a condenser and an inductance are connected in series with the alternator and ammeter. Assuming resistance still to be zero and remembering that the effective reactance in ohms is equal to the inductive reactance minus the capacity reactance, or vice versa, the remainder taking the name of the larger component. This is found to be 3180 minus 3140 ohms, or only 40 ohms capacity reactance. In the circuit of Fig. 5, therefore, a voltage of 100 at 100,000 cycles would cause 2.5 amperes to flow through the condenser and inductance in series. This is over 750 times as much current as would flow through either the condenser or the coil alone, and is made possible by the neutralizing effect above stated. If the condenser were of slightly more than 0.0005 microfarad capacity, so as to make its capacity reactance exactly equal numerically to the inductive reactance, these two elements would neutralize completely, for the total reactance would be zero. If the resistance were also zero there would be no limit to the current in the circuit; in practice there is always some resistance in circuit, and this determines the number of amperes which will flow through the circuit for a given voltage, if the resonant condition exists.

Fig. 6 shows the practical closed circuit of capacity, inductance and resistance. The current in amperes equals the e. m. f. in volts divided by the impedance in ohms. The impedance equals the square root of the sum of the square of the resistance and the square of the

total reactance. The total reactance is found by subtracting the capacity portion from the inductance portion, each computed as above. When the condenser and the inductance are chosen so that they neutralize each other for the operating frequency, the impedance reaches its lowest possible value and equals the simple resistance. This condition of balanced reactances, therefore, gives the largest possible current for any applied voltage of the given frequency. The circuit in this condition is in *resonance,* and the frequency for which the capacity and inductance neutralize is the *resonant frequency.*

The antenna circuit of Fig. 1 is in many ways equivalent to the closed circuit of Fig. 6. The aerial itself possesses capacity, inductance and resistance, and the coil B adds to the system inductance and resistance. If the total inductance of the circuit is adjusted by varying coil B so that it exactly neutralizes the capacity of the antenna for the frequency of the alternator E, the antenna will be *resonant* or *tuned* to this frequency and the greatest aerial current will flow. If the inductance is changed, or if the frequency of E is altered, the reactance will at once commence to grow large and by increasing the impedance will cut down the antenna current and the radiated waves.

In the next article further useful applications of resonance will be described, and additional simple computations explained.

Recent Radio Inventions

By A. F. Jackson

A patent issued during 1915 to C. D. Ainsworth and bearing number 1,145,735 shows an interesting arrangement of three-electrode vacuum-tube detector. Fig. 1 indicates the construction of the device and the circuit connections. Referring to this drawing, within an evacuated glass bulb *1* is sealed a support *8* which carries a tubular anode *2* and two electrodes *4* and *6*, also in the form of tubes and concentric with the central conductor. The two outer cylinders are made of woven wire, *4* (which may correspond to the grid of an audion) being of somewhat finer mesh than *6*. The tube is operated cold, i. e., without a filament heated by auxiliary current, and secures its conductivity through the radio-active material, such as uranium, which is placed near the electrodes at *9*. The usual circuits, combining antenna and ground with inductively coupled secondary coil *10* and tuning condenser *11*, are used. The central electrode, however, corresponds approximately to the plate in the usual audion arrangement, and is connected to the positive terminal of the battery *3* through the telephone *12*. No series condenser in the circuit of electrode *4* is shown.

The patentee explains the operation of the detector by saying that the rarefied gas within the tube is made conductive by the radiation from *9*, which may be a compound of uranium, thorium, radium or actinium, and that consequently a steady small current tends to pass from *2* to *6* and to *4*. The voltage of *13* is adjusted just below that which will "break down the electrical resistance of

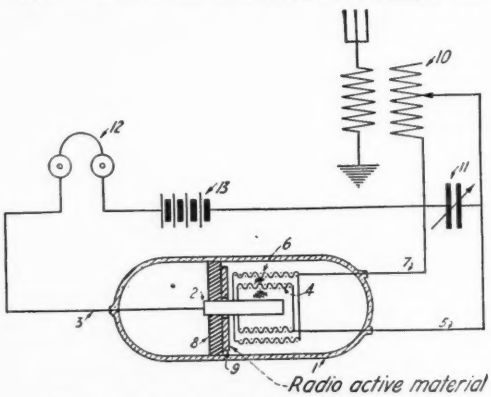


Fig. 1. An interesting arrangement of three-electrode vacuum-tube detector

the ionized gas" when no signals are being received; but when currents are induced in the secondary system from the antenna, a re-distribution of potential takes place and the battery flows, so producing a signal in the telephones. This described operation is therefore

closely analogous to that of an autocoherer, in which incoming-wave energy changes the resistance of a conductor and thus alters the amount of current flowing through it from a local battery.

In his early experiments with the audion, Lee deForest is said to have used radio-active compounds in place of the heated filament, but without success be-

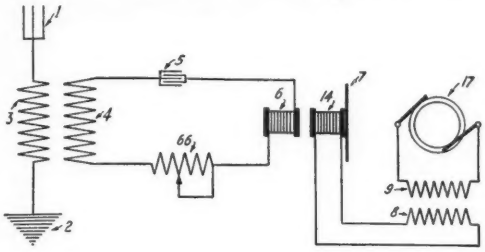


Fig. 2. A heterodyne receiver, operating on the electrical beats principle

cause of the difficulty in securing sufficient conductivity by ionazation. The detector of the Ainsworth patent should prove a useful instrument when developed to a practical operating point, since, as the patentee points out, constancy in operation may be expected and the nuisance and expense of filaments and heating batteries are done away with.

U. S. Patents 1,141,386 and 1,141,453, issued in 1915 to R. A. Fessenden, show not only a simple "heterodyne" receiver operating on the electrical-beats principle now so widely used, in Fig. 2, but also a method for simultaneously sending and receiving with continuous waves, as in Fig. 3. Taking up the first of these, it is seen that the antenna *1* is connected to ground *2* through the primary of the inductive coupler *3*. The secondary *4* has in series with it a variable tuning inductance *66*, a condenser *5* and one winding of an electro-dynamometer-telephone, *6*. The second telephone winding *14* is coupled to a small radio-frequency alternator *17* through a transformer *8*, *9*. The dynamometer *6*, *14*, consists of two coils placed end to end, one of which is stationary and may have a fine iron-wire core and the other of which is mounted upon a diaphragm *7*. In receiving radio signals the antenna and secondary systems are tuned exactly or approximately to the frequency of the incoming waves, so that currents of this frequency will be induced in coil *6*. The alternator, *17*, is then run at a radio frequency slightly different from that being received, and its current output led to coil *17*. The magnetic fields of these two coils interact one upon the other; when the currents are relatively in one direction, the fields add and the diaphragm, *7*, is attracted, and when the currents are relatively reversed, the fields oppose each other and the diaphragm is repelled. This alternate adding and opposing of fields goes on constantly because of the slight difference in frequency of the two currents, and the diaphragm is moved back and forth at a rate determined by the difference in the frequencies. If the incoming wave is of 6,000 meters length, which corresponds to 50,000 cycles per second frequency, and the local generator produces currents of 50,500 cycles frequency, the number of impulses impressed upon the diaphragm will be 500 per second. This last is called the "beat frequency" of the heterodyne receiver, and is the frequency of the signal tone heard by listening to the telephone diaphragm, *7*. No beats or impulses on the diaphragm are produced unless *both* currents are flowing; there-

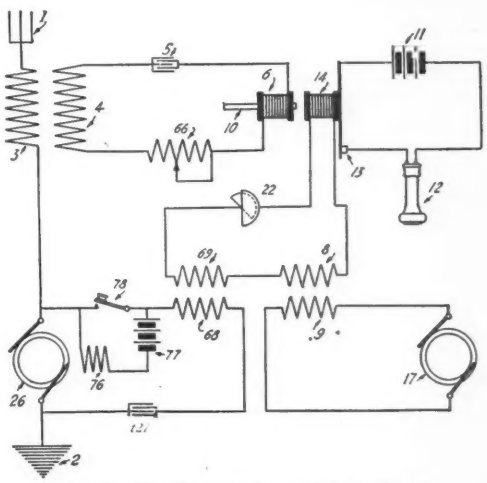


Fig. 3. Sending and receiving simultaneously with continuous waves

fore, although power from alternator *17* is constantly flowing, signals are heard only when waves are received on the antenna from the distant sending station. This dynamometer heterodyne gives a much louder signal than could be ob-

tained from the magnetic effect of the incoming waves applied directly to a suitable air-core or self-excited telephone, since the magnetic force acting on the diaphragm depends upon the product of the two currents in the coils *6* and *14*, and that in *14* from the local generator may be made quite large.

Figure 3 shows the duplex heterodyne system. Here the receiver just described has added to it, in series with the antenna, a radio-frequency alternator powerful enough to generate the strong waves used in sending. This transmitting alternator has its field coils, *76*, supplied with power through the sending key, *78*, and also has connected across its armature terminals a circuit which is

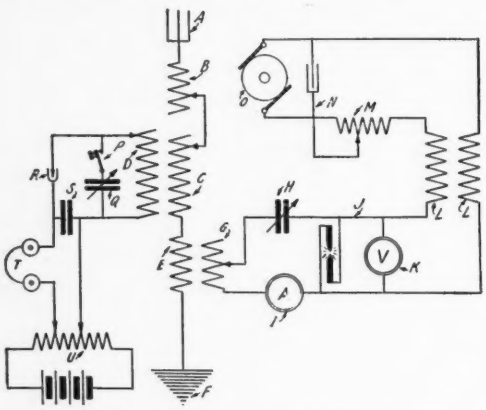


Fig. 4. An improved form of heterodyne receiver

coupled to the receiver coil, *14*, by way of transformer *68*, *69*. The condenser, *27*, may be inserted to tune the auxiliary circuit. All the other main elements of Fig. 3 are the same as shown in Fig. 2, except that variable condenser *22* may be added to make the diaphragm-coil circuit resonant.

When the sending key, *78*, is open the sending generator, *26*, does not generate and the system is entirely equivalent to that shown in Fig. 2, since all the receiving portions are operative. When the key is depressed to make a Morse dot or dash, however, the generator field circuit is closed and intense radio-frequency currents are set up in the aerial system. These induce strong currents in the receiver coil, *6*, which might have so great an effect on the diaphragm as to make receiving from the distant station impossible. Closing the key, however, connects in the circuit *27*, *68*, and through the coupling transformer similar, but opposed strong currents are set up in the receiver coil *14*. The intensity and phase of these is adjusted so that their magnetic field exactly neutralizes that of the transmitter currents in coil *6*, and the diaphragm is therefore left undisturbed and in receiving condition even though the key is pressed down. Thus the aerial is used for sending at the same time it receives.

This duplex system makes possible the transmission of twice the normal amount of traffic between two radio stations, for messages can pass both ways simultaneously. Since the same aerial is used both for sending and receiving, there is no need for erection of separate sending and receiving stations located some distance apart and connected by wire lines, as is done at the Marconi trans-oceanic plants.

The patent specification points out a number of variations of both simple and duplex heterodyne operation; for instance, the telephone receiver may be mechanically tuned to the beat-note frequency, or the action of the dynamometer may control a microphonic-contact relay (*13*, Fig. 3) operating an ordinary telephone *12* by varying the current from a local battery *11*. It is also suggested that, instead of currents, the voltages set up by the received waves may be used to interact with locally generated radio-frequency voltages, upon an electro-static telephone, to produce heterodyne beats and a musical signal.

An improvement upon the dynamometer heterodyne just described is the subject of 1915 U. S. Patent number 1,141,717, issued to J. W. Lee and J. L. Hogan, Jr. In principle this receiver is identical with the older forms of heterodyne, but instead of adding the effects of the incoming and locally generated currents mechanically upon a dynamometer device, the two are combined electrically. As shown in Fig. 4, a normal receiving outfit is first set up. This may consist of the antenna *A*, having in series with it to ground *F* a loading coil *B*, the primary

of the receiving coupling *C* and the secondary of another oscillation transformer *E*. The secondary *D* may have the tuning condenser *Q* connected across its terminals leading to the detector *R* and stopping condenser *S*. Across this last named are connected the ordinary telephones *T* and potentiometer with battery, *U*. In addition to these usual receiving instruments, a generator of radio frequency current is coupled to the oscillation circuits. This may be, as shown in Fig. 4, an oscillating arc *J* having the resonant condenser *H* and inductance *G* connected serially across it and fed with direct current from *O* through resistance *M* and choke coils *L, L*.

The heterodyne operation of this receiver may be explained with reference to Fig. 5, which is a series of curves roughly representing the currents in the several circuits. The upper line, *N1*, indicates the incoming-wave currents as they would be set up in the antenna and secondary circuits if signals were arriving but the local oscillator were not in operation. The second curve *N2* shows the current of slightly different frequency which is generated by the local oscillator itself, as it would be induced in the receiving circuits if no signals were being received. The third curve, *N3*, represents the beat-current which is produced in the circuits when signals are being received and the local generator is running; this current is seen to change from zero to maximum strength regularly, according to whether the two interacting currents aid or oppose each other. This varying radio-frequency current has a beat frequency equal to the difference of the two radio frequencies, just as in the simple magnetic heterodyne, and, when rectified by the detector *R*, produces in the telephone circuit a pulsating direct current corresponding to the heavy curve on axis *N4*. These pulses of course act on the telephone diaphragm in the well known manner and produce a musical signal tone of the beat-frequency.

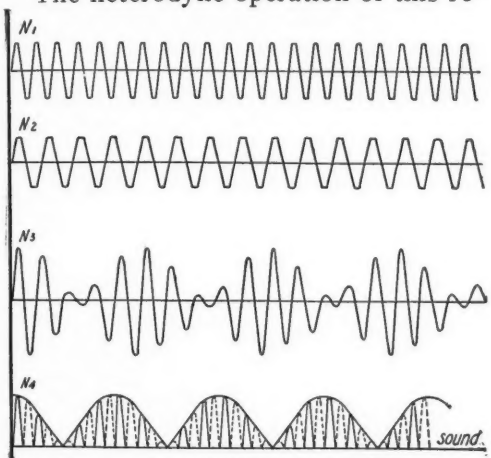


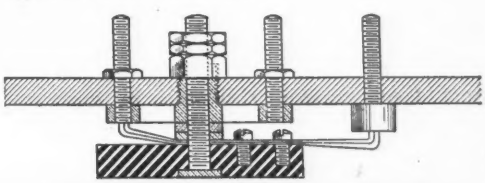
Fig. 5. Curve indicating operation of new rectifier heterodyne

This recent type of heterodyne is the forerunner of many receivers used today for continuous wave signals. In some of these the local oscillator is a suitably arranged audion bulb and the detector a second audion. Occasionally amplifiers are added, and a very sensitive receiving system thereby obtained. In some instances the same audion bulb is used as a local generator, and, simultaneously, as the detector and amplifier. The basic method of operation can be traced back, however, to the heterodyne principles explained in the above three patents and outlined herein.

A Multiple Point Switch

THE drawing shows a positive contact, smooth running multi-point switch, having ½-inch diameter switch points on ¾-inch centers, with the width of contact arm ⅞-inch. It may be seen from the drawing that all movable contacts are of the self-cleaning knife edge type. An attractive and substantial instrument is the result.

This switch may be used on the high voltage audion battery circuit by leaving each alternate contact point dead, and making connection through the central contact ring. This protects the battery against short circuits.



This switch may be used on a high voltage audion battery circuit

Radio Stations in Alaska

By Vincent I. Kraft

RADIO communication plays an important role in Alaska. Many cities and towns which would otherwise be isolated are kept in touch with the rest of the civilized world by this agency alone, and the United States Government employs it to communicate with government vessels in North Pacific waters, and to receive the weather reports from all parts of the northland. Remote as Alaska is from the source of radio inventions and improvements, the Alaskan stations represent strictly up-to-date methods of radio communication.

During the past few months a great deal of construction work has been done in Alaska, both in improving the existing stations, and in the erection of new ones. The past year has witnessed the completion of the Ketchikan unit of the new chain of semi-high-powered stations. Here the Marconi Company has built a 25 kw. plant, which is at present in daylight communication with a similar outfit located at Astoria, Oregon. This first span of the new chain is over a distance of 640 nautical miles, and connects Ketchikan, the southernmost city of importance in Alaska, with the United States. Astoria was chosen as the United States terminus of the chain, after a series of tests in many parts of Washington and Oregon, on account of its natural adaptability to Alaska work.

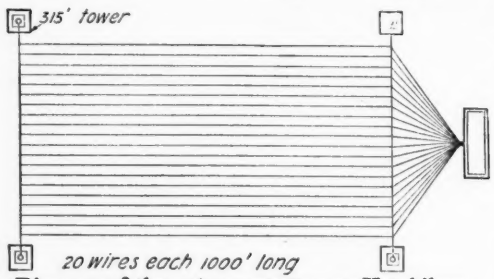


Diagram of the antenna system at Ketchikan, Alaska

Another station, of ten kilowatts capacity, will soon be erected at Juneau, the capital of Alaska, and will be within daylight range of the Ketchikan station. The erection of a fourth station, in the vicinity of Seward, the terminus of the new Government railroad, is contemplated. Other stations will probably be erected later.

This chain of stations will be capable of rendering service that the United States Army cable does at present, between the United States and the above-mentioned points. Experiments are still being conducted between Ketchikan and Astoria, the longest of the spans, and although the wave lengths that will be employed in actual commercial communication had not been definitely determined upon up to last August, it had been found comparatively easy to cover the distance satisfactorily, using waves between 3,000 and 5,000 meters in length. Signals ranging in strength from 1,000 to 1,500 times audibility are received at Ketchikan from Astoria in daylight, and this intensity is considerably more than necessary for good commercial operation, employing a typewriter at the receiving station.

The installation at Ketchikan, the largest of the stations of the new chain, includes four steel towers of the self-supporting type, 315 feet in height, between which is supported an antenna of 20 wires 1,000 feet in length. The station is equipped with a 60-cycle transmitter of 25 kw. rated capacity, provided with a synchronous disc discharger. The transmitter is able to operate at 100 per cent. overload. The receiver is of the standard Marconi panel type, adapted to the reception of waves up to ten thousand meters in length. The station at Astoria, Oregon, is a duplicate of the Ketchikan installation.

The United States Navy, which has maintained stations for many years in Alaska, is improving its present installations and building new ones. The station at St. Paul (Pribilof Islands), since its erection some four years ago, has been equipped with a set of five kw. capacity Telefunken apparatus. The

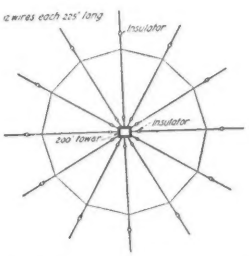
Navy is planning to increase the height of the masts to 500 feet and install a 25 kw. set in addition to the present 5 kw. one. The new set will be of the Poulsen arc type, for the generation of continuous waves. The station at Unalga Island has been dismantled, and that at Dutch Harbor (Unalaska) will be increased in size, to make it capable of handling the traffic heretofor handled by the Unalga station. Unalga and Dutch Harbor are only eighteen miles apart, and it was not deemed necessary to maintain both stations.

These two stations are peculiarly well located for long distance radio work. The station at Unalga Island has several times been in direct communication with the United States Navy station at Key West, Florida, nearly six thousand miles distant, although the power employed at Unalga Island was only ten kw. The operators at Unalga claim to have copied quite regularly, during the winter months, many stations on the Atlantic coast, in spite of the fact that Unalga Island is located more than fifteen hundred miles west of the Pacific coastline of the United States. Stations in Japan, Russia, China and the Philippine Islands are heard regularly and were it not for the fact that the Asiatic stations use languages other than English in their regular work, the operators at Dutch Harbor or Unalga Island could easily communicate with them.

The station at Wood Island (Kodiak) is one of the most efficient the Navy has in Alaska. This is undoubtedly due largely to its favorable geographical location. Kodiak is within daylight range of St. Paul (575 nautical miles distant), Cordova (260 miles), and Sitka (530 miles). Occasionally Kodiak has been in daylight communication with Unalga Island, and it is very probable that, when the improvements at the Dutch Harbor station are affected, that station will be in daylight range of Kodiak. The station at Cape Whiteshed (Cordova) has been rather unsatisfactory for long distance work, although this station is equipped in an up-to-date manner with a ten kw. Telefunken set. This may be due to a poor location.

The station at Sitka is one of the first put up by the Navy in Alaska, and has done very efficient work, although not until recently has it been equipped with the latest type apparatus. At present two sets are installed, one being a five kw. Telefunken set, and the other a 20 kw. 240 cycle synchronous rotary discharger set.

The installation of vacuum tube amplifiers in all the Navy stations of Alaska, recently, has made a marked improvement in the service rendered. Stations that have previously had difficulty in maintaining communication are now working without trouble. The working range with vessels is also materially increased thereby, as the amplifiers enable the Navy stations to receive signals from the 1 and 2 kw. sets on board ships, as far as the ships are able to receive signals from the five and ten kw. equipments of the Navy stations, and oftentimes farther. The Navy has but recently inaugurated a new service, whereby vessels in communication with its Alaska stations may send in reports of their positions daily, which are to be relayed without charge to the Navy station at North Head, Wash., where the position reports are turned over to the telegraph lines for transmission to the daily papers of the Pacific Coast. By this service, the reports of positions of vessels in Alaskan waters each night, are published in the following morning's papers in all the principal cities of the coast.



Umbrella antenna used on Alaska stations

Heretofor the Alaskan station have been able to communicate with North Head at night only, but since the installation of the audion amplifiers, daylight service has been possible to a limited extent between North Head and Sitka, using waves under 2,000 meters in length. This is over a distance of 780 nautical miles. During the summer months there is but an hour or two of darkness each night, and during the latter part of June and the early part of July, it does not get even completely

dark. This has made it very difficult to handle traffic during the summer months and as the communication is limited to the period of darkness, it has frequently happened that more business has been offered than could be despatched during one night. For this reason, the Government has been desirous of installing equipment, capable of handling traffic between North Head and Alaska, during all seasons, day and night. With this object in view, the Navy has ordered a thirty kw. arc set to be installed in the present Cordova (Cape Whiteshed) station, to test with North Head. By employing continuous waves of great length, generated by this set, it is very probable that the desired daylight communication will be established. A much larger station will also be erected near Cordova, at Mile 13 on the Copper River and Northwestern Railroad. Here will be installed a one hundred kw. arc set, which will insure continuous communication between Alaska and the United States, and may make direct communication with Arlington (Va.) possible.

The adoption of the arc type transmitter, by the Navy, marks a long-foreseen step in advance, and the results of the tests to be conducted by the Navy will be watched with interest by the engineering profession. If the operation of the continuous wave transmitters proves satisfactory between the United States and Alaska, where the conditions are unusually trying, it is not improbable that they will be installed throughout the Navy service.

The Signal Corps, of the United States Army, operates a chain of stations throughout the interior of Alaska, with stations on the coast at Nome, St. Michael, Kotlik, Petersburg and Wrangell. These stations serve districts where the maintenance if not the construction of a landline would be a very difficult matter. The Signal Corps stations work in conjunction with the United States-Alaska cable system, and the interior land telegraph system, both of which are owned by the Signal Corps. In the interior many points have radio stations as the only means of communication, because the extremely heavy snow fall prohibits the use of telegraph lines. Between Nome and St. Michael, a distance of about 120 miles, it was found, after many futile attempts, impossible to keep a cable intact, during the winter months, on account of the heavy ice floes, which carried the cable away. Accordingly radio stations were erected at these points, and all cable or telegraph traffic for Nome is now sent by radio from St. Michael. A somewhat similar condition exists between Wrangell and Petersburg, in Southeastern Alaska, but in this case it is the tides in Wrangell Narrows, rather than ice floes, which make the maintaining of a cable difficult.

With few exceptions, the Signal Corps stations in Alaska are of one uniform type. The regulation equipment consists of a single 200-foot steel tower, from which is supported a 12-wire umbrella antenna, and a ten kw. Telefunken set. Receiving equipments include both Telefunken and I-P-76 Tuners. Most of the stations have counterpoises.

Another group of radio stations in Alaska, is the group of salmon cannery stations. The majority of salmon canneries are located at points distant from the cable or telegraph lines, and for their own convenience, the owners have installed, or leased, small sets. These stations work with Government or Commercial stations, and afford a means of communication with the outside world. These sets, at small expense, handle business between the canneries and the home offices of the packing companies, in the United States, that would otherwise have to go by the slower mail. These stations are in operation during the canning season only, which lasts from about May to September, and are some ten or fifteen in number.

In times past, when the Seattle-Alaska cable has broken, the radio stations of the Government, in conjunction with the commercial stations of Alaska have satisfactorily handled the heavy traffic although these station then had low-powered sets, and were able to hold communication at night only. With the completion of the improvements and new installations now planned for, however, the radio system of Alaska will be capable of giving uninterrupted service between the United States and most of the important points of Alaska.

New Books on Radio Subjects

TEXT BOOK ON WIRELESS TELEGRAPHY. By Rupert Stanley. Published by Longmans, Green & Co., New York, 1914. 344+XII pp., 200 illus. Price, $2.25.

THIS book, by the professor of physics and electrical engineering at the Municipal Technical Institute, Belfast, Ireland, is intended to furnish a proper introduction to the technical problems of radio signaling. The common fault of assuming on the part of the student either on extended knowledge of electrical theory or an interest in long mathematical discussions has been avoided. The author omits consideration of items which do not lead directly to a clear understanding of radio transmission, but gives full treatment to the physical phenomena which are especially concerned.

Of the twenty chapters the first four may be said to discuss the abstract topics of electrical radiation and energy transfer. The next two take up electrical units as measured and calculated, and the particular effects of capacity and self-induction. After descriptions of induction coil, transformer and alternator operation, and of oscillatory discharges of condensers, a brief history of radio is given in Chapter IX. Later chapters describe the operation of spark and sustained wave transmitters and receivers, the phenomena appearing in coupled circuits, the use and adjustment of telephone amplifiers, etc. A final chapter on radio telegraph measurements leads to appendices of codes and regulations, which, with a short index, complete the book.

In taking up the elements of electricity, the electron theory is used as a basis of explanation. The descriptive portions of the book are excellent, and the discussions of theory seem clear. The Goldschmidt, Poulsen, Marconi and Lepel arrangements for continuous wave operation are shown, and the plate quenched gap and older spark apparatus are described in detail. More attention is given to British Marconi apparatus than that of any other firm; many constructional and wiring diagrams of various Marconi, Telefunken and other instruments are shown.

The book can be recommended for careful study by anyone who desires not only a good technical acquaintance with radio but also a fair degree of familiarity with recent wireless telegraph practice.

WIRELESS TELEGRAPHY. By J. Zenneck. Transl. by A. E. Seelig. Published by McGraw-Hill Book Co., New York, 1915. 443+XX pp., 469 illus. Price, $4.00.

This translation into English of Professor Zenneck's "Lehrbuch," the classic of radio telegraphic technical literature, is sure to be welcomed. Although many of the interrelations of electrical quantities are stated mathematically and in such form as to make a knowledge of the calculus desirable, nearly all these statements are explained so clearly that even the student who possesses only slight acquaintance with electrical matters can find much information in useful form. The book is thorough, and the radio reader will find as he advances in his work he will get out more and more as he rereads it.

Chapter I is on condenser circuits and their oscillations, Chapter II on "open" or radiative circuits. Measurement, calculation and effects of frequency, damping, energy losses, and electromagnetic fields are described. Chapter III discusses the relations of resistance, inductance and capacity, current and voltage in the high frequency alternating current circuit, and explains current measurements. Coupled circuits, with magnetic, conductive and static linking, are taken up in Chapter IV, and the distinctions are brought out contrasting quenching against non-quenching operation, as well as damped oscillations against sustained currents. The next chapter is on resonance and its measurements, while Chapter VI treats grounded antennas. Chapter VII, on transmitters of damped oscillations, describes first the plain antenna sender, second, the coupled tuned-circuit transmitter and, third, the quenching apparatus. This classifica-

tion as well as the application of the names Marconi, Braun and Wien successively to the three types, is perhaps open to criticism. Radio frequency alternators of Fessenden and Goldschmidt, and the arc senders of Poulsen and Lorenz, form the subjects of the next two chapters. The tenth chapter, on the propagation of waves over the earth's surface, contains much interesting material as to the effects of earth resistance and capacity and of atmospheric changes. Chapters XI and XII describe the operation of detectors and receiving arrangements for both damped and sustained waves. The last two chapters are on directive transmission and radiotelephony, respectively. Some notes on progress up to 1912, a series of useful tables, a bibliography and set of notes on theory and a very full index complete the book.

This American edition is especially well printed and sets a high mark to be reached by other technical publications. As a reference work alone, recording and describing accomplishments in the radio arts, the book should be extremely useful to radio-engineers. As a text for a thorough course in both theory and operation of radio instruments its value can scarcely be overrated. Since the treatment is almost entirely a matter of facts undisputed by real authorities, the tendency to favor German workers on historical points may easily be overlooked in view of the importance of their technical work.

Radio Club News

Schenectady Radio Association

THE Schenectady Radio Association, which was formerly known as the Amateur Wireless Association, held its annual election of officers in September, with results as follows: R. Denham, president; H. Vogel, vice-president; L. Pohlman, secretary; S. Dodd, assistant secretary; E. Kurth, treasurer, and A. LeTarte, librarian.

The association meets every Thursday night in the High School building, where it has a 1 K.W. outfit. The unofficial call letters are S. R. A. The Association welcomes any visitors who wish to attend its meetings, and would like to correspond with other similar clubs and persons interested in the radio field.

The association is also planning to send representatives to New York city, to meet members of other organizations and would like to hear from them.

Cincinnati School Radio Society

The East Night High School Radio Society was organized with a membership of 52 amateurs and students of the school, in October, 1915. Officers elected at the first meeting were Wm. G. Finch, President; C. H. Fender, Secretary; Professor Frantz, Treasurer. It is proposed to install a modern 5 kw. radio set, and thus to train the membership into a thorough knowledge of radio operating conditions. The secretary, who may be addressed in care of the school, Cincinnati, Ohio, will be glad to hear from the members of other nearby organizations.

Bronx Radio Club

At the last meeting of the Bronx Radio Club of New York, election of new officers was held. The results were as follows:

M. Haber, President; H. Berlin, Secretary; J. Smith, Vice-president; A. Richter, Treasurer; A. Schoy, Business Manager.

A lecture was delivered by one of the members on "The Theory of Wireless Transmission." Lectures are given at every meeting, by the more advanced members of the club, dealing with timely topics of wireless or electrical interest. The club will be glad to communicate with other clubs and individuals, desirous of having information or particulars of the proceedings of the club. All communications should be addressed to the Secretary, 705 Home St., Bronx, N. Y.

What Radio Readers Want to Know

Increasing an Umbrella Aerial.

C. A. P., Fresno, Cal., asks:

Q. 1. Would it be advisable to add 2,000' of wire to my umbrella aerial?

A. 1. If you add the wire so as to make the length of the antenna greater it will be advisable to add the amount of wire you mention. It would be better if you could arrange so as to have this wire extend 300 or 400 feet out from the pole. This would give you a longer fundamental wavelength, which is necessary when receiving from stations using very long wavelights for transmission.

Q. 2. Can I hear Arlington with a silicon detector?

A. 2. It is possible that you could hear NAA. Stations along the Atlantic coast with aerials no larger than yours have heard the high power stations of the Pacific coast. Very recently we had occasion to note the reception of Berlin by an amateur station in Massachusetts. The operator used an oscillating audion in connection with a home-made receiving set. His aerial was about 150 feet long and 50 feet high, although 300 feet above sea level and in sight of the ocean. Very excellent work is being done by well informed amateurs who are using oscillating audions.

Q. 3. What is the best receiver for long distances?

A. 3. We would advise you to equip your station with an oscillating audion. For information regarding audions, oscillating audions, radio telegraphic transmitting and receiving apparatus write to the DeForest Radio Telegraph & Telephone Co., 101 Park Avenue, New York City. Be sure to mention the fact that you desire the instruments for amateur experimental work, as the price is very much lower for this kind of work than when sold for commercial operation. They will supply you with bulletins covering the subject on request.

Q. 4. What station uses call 2GN?

A. 4. We have no record of these letters being assigned as yet.

Radio Receiver Information.

M. H., Wilmette, Ill., asks:

Q. 1. What is the natural wavelength of an inverted L aerial of total length 85 ft., 5 wires on 9 ft. spreader, and 55 feet high?

A. 1. About 200 meters.

Q. 2. What size wire is most efficient for a loose coupler to receive 600 meter wavelengths?

A. 2. It makes very little difference what size wire is used. In general the useful sizes run from about No. 22 to No. 28 B. & S. gauge.

Q. 3. What would be the dimension and size of wire necessary to make a loading coil from 10,000 meter wavelengths?

A. 3. Wind No. 28 S. C. C. magnet wire on a cylinder 5" in diameter and about 30" long.

Q. 4. Does the secondary circuit also need loading?

A. 4. Yes, or the two circuits would not be tuned to the same wavelength. The secondary circuit is usually increased in period by shunting the secondary of the tuner with a variable condenser of large capacity. Loading inductance is also used the same as for the primary.

Receiving Set For Amateurs.

J. A. Strossman, Mt. Sterling, asks:

Q. 1. I have a four-wire aerial 90 feet long, 50 feet high at one end and 30 feet high at the other. Is this a fairly good aerial for amateur use?

A. 1. We should consider it quite satisfactory.

Q. 2. What is the natural wavelength of this aerial?

A. 2. About 225 meters.

Q. 3. How many miles should I receive with this aerial, using a double slide tuner, galena detector, and 1,000 ohm receivers?

A. 3. Local conditions so affect the receiving range that it is even worse than guessing to try to give any distance. For this reason we do not publish receiving distances in this column.

Q. 4. What is the best all around detector for amateur use?

A. 4. Galena is usually considered the most sensitive of the single minerals. Silicon will keep its adjustment better but is not as sensitive as galena.

Radio Abbreviations.

A. R. L., Pittsburgh, Pa., asks:

Q. 1. Will you please give me the meaning of the following abbreviations used in sending radio messages? CK, HR, SRNS.

A. 1. CK is the abbreviation for *check* used to state the number of words in the message. HR stands for *here* and is used to indicate that a station has a message there for transmission. It is sometimes used to acknowledge the reception of a message. We can find no reference to your third abbrevia-

tion, although the first two letters SR are often used for *senior,* especially in combination with some other abbreviation indicating the title of the person addressed. The abbreviation you mention may be of this type.

Loose Couplers and Stranded Copper.

R. M. L., Indianapolis, Ind., asks:

Q. 1. Will you please inform me as to the sizes of the primary and secondary cylinders, also the sizes of the wire primary, and secondary needed to make a loose coupler with which I can receive signals of a 4,000-meter wavelength?

A. 1. Make the primary 5¼ inches in diameter and 16 inches long; the secondary 4¾ inches in diameter and 16 inches long also. Wind both coils with No. 28 wire. Use bare wire if possible, if not use single cotton covered magnet wire.

Q. 2. Will you please inform me whether it is necessary to use a tikker to receive Arlington, NAA, when using its new continuous wave set?

A. 2. Yes, unless you use some other method such as the oscillating audion, which is capable of receiving undamped waves.

Q. 3. Will you please advise me what kind of wire should be used in the aerial for long distance receiving?

A. 3. Stranded copper is quite satisfactory. There is made a special seven-strand tinned copper wire for antenna purposes which will work very well. This wire costs about a cent per foot and can be obtained from nearly any wireless supply house. Phosphor bronze is also used and has the advantage of being stronger than copper, and it is also more expensive.

Trouble With a Half Kilo-Watt Transformer.

K. T., Scranton, Pa., asks:

Q. 1. I have built a one-half kilo-watt transformer of the Type E design for radio work and find that instead of taking five amperes it takes but two or three. I used stove pipe iron instead of silicon steel called for by the designers. Would it be all right to reduce the number of turns on the primary to cause the transformer to take a larger load?

A. 1. Yes, on the transformer you mention this would be satisfactory. Care should be taken that the safety gap on the secondary is not opened too far, as a higher voltage will be induced in the secondary if the primary winding is shortened. Are you sure that you are using the same size condenser on the secondary that is called for by the designers? Many transformers for radio work were designed before the Federal radio law was passed and were intended to be used with a larger condenser than is now permissible. Accordingly instead of drawing 5 amperes these transformers are only taking 2 or 3 with the lighter load. These transformers are having their primary winding reduced, causing an increase in secondary voltage, and accordingly a larger load on the transformer. We are rather surprised to find that your transformer is taking less current than expected, unless it is the condenser question, for in general transformers constructed by amateurs are noted for their high current consumption.

Some Miscellaneous Information.

H. S., Chicago, Ill., asks:

Q. 1. Would there be any change in the connections of an ordinary receiving set if the set was to be used on wavelength of 10,000 meters?

A. 1. No, the usual connections with loading coils would be used.

Q. 2. In receiving long wavelengths is it necessary to load both the primary and secondary circuits?

A. 2. Yes. The primary is usually loaded by putting a loading coil in series with the primary of the receiving transformer. The secondary is usually brought up to the long wavelength by shunting the secondary of the tuner by a condenser of large capacity.

Q. 3. What would be required to load a 2,200 meter set up to 10,000 meters?

A. 3. For the primary wind about No. 26 wire on a cylinder 5 inches in diameter and 3 feet long. The secondary would be best loaded by adding a small loading coil in series with the secondary of the receiving transformer and shunting the coils with a variable condenser of about 0.008 m. f. capacity.

Q. 4. In the primary circuit is it considered best to put a variable condenser in shunt with only the tuner rather than around both the loading coil and tuner?

A. 4. Yes.

Q. 5. How many condenser plates 12x14 inches do I need for a 1 KW. transformer with secondary voltage of 20,000, using a rotary gap? By 12x14 inch plates I mean the size of the glass, the actual surface of metal being only 9x11 inches. The glass is ⅛ inch thick. Wavelength 200 meters.

A. 5. Your set will probably require about six plates.

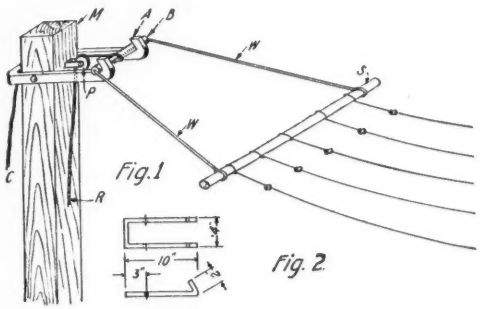
Q. 6. What is the best material to use for connecting up the transmitting instruments?

A. 6. Copper ribbon is about the best thing for general use.

Radio Construction Notes

A New Aerial Supporter

AMATEURS having high masts are often troubled by having their hoisting ropes shrink in wet weather. A remedy which also prevents the spreader from tilting is shown herewith. Re-



Sketch and construction of a steady aerial supporter

ferring to the sketch, piece A is of ⅛-inch strap iron, ½-inch wide and 2 feet 4 inches long. Have a blacksmith bend it as shown and drill two ¼-inch holes, one on either side, 3 inches from the bent end.

In mounting it on the mast it should be on the same level as the pulley. The closed end must clear the mast by about an inch when it is in the horizontal position. Long screws should be used to fasten it to the mast and it should be so loose that the ends with the hooks on will drop down when the light cord C is released. About ⅛-inch diameter is a good size for this cord.

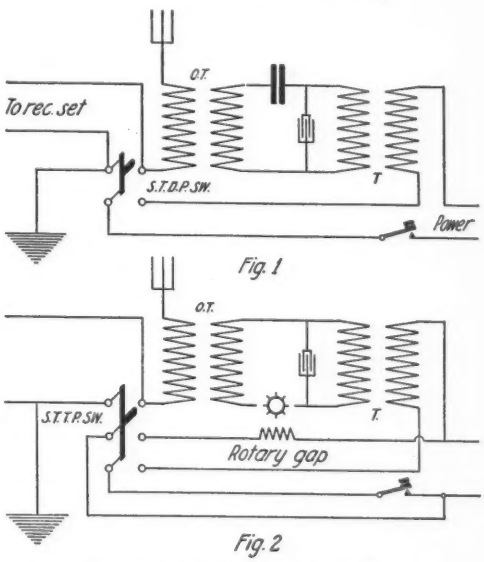
Piece B may be either an iron or wooden rod 6 inches long. It is fastened to the spreader with two No. 14 galvanized wires. The rope R passes through pulley F and is fastened to the middle of piece B.

The aerial is raised by means of hoisting rope R until piece B is against the pulley D, and then the hooks on A are raised by pulling on cord C. Rope R is then slackened until piece A alone supports the aerial. To lower the aerial simply pull on rope R until the hooks disarrange themselves and then lower away.

A Simple Change-Over Switch

A GOOD many cases of poor sending and receiving results may be traced to a poorly insulated change-over switch. One that will cost less than fifty cents and will give as good results as a more expensive one is an ordinary double-pole, single throw switch such as is used in the lighting circuit. This is connected as in the diagram. When the switch is open, the incoming waves will go through the loose coupler; when the switch is in, the receiving set is short circuited, and the power circuit is closed. Thus, when receiving, an accidental touch of the key will do no harm, as the power circuit is broken.

If the station has a rotary gap, a triple pole switch may be used, the extra blade connected in the gap motor circuit as in Fig. 2. Thus, throwing the switch will start the rotary gap.



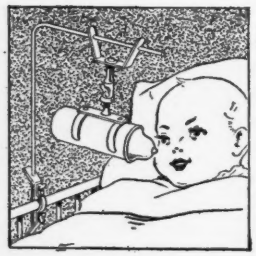
Connection diagrams for ordinary switch used as change-over

A Condenser's Power

AT 60 cycles a condenser will store 1 kw. of power if its value is 0.019 microbarad and it is charged to a voltage of 30,000. This e. m. f. corresponds to a spark gap slightly under one-half inch in length.

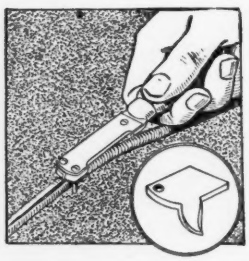
What's New in Patents

Baby's Bottle-Holder



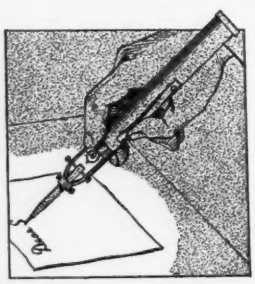
AN adjustable arm is designed to be affixed to an infant's crib or cradle. Attached to the end of this arm is a device for holding a nursing bottle. A bottle is placed in the clamp and its position may be readily fixed and adjusted. This device allows the feeding of an infant without the presence of the mother or nurse.

Tool for Stripping Insulation



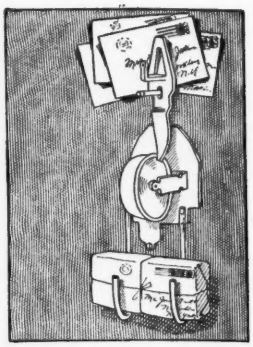
FOR the splitting of the outer wrapping of an insulated electric wire the tool has a laterally projecting blade in the center of two projections which serves as guides while it is being drawn along the wire. On the side of the instrument is a blade which strips the insulation from the wire when the outer covering has been split away.

Electrically Lighted Pencil



TO the end of a slender dry battery terminating in a bulb is threaded a clamp which by means of set screws holds a lead pencil. A leaf spring switch is affixed to the wall of the battery so that the circuit may be easily made. When the switch is pressed the bulb is lighted, and the light is thrown upon the paper directly in front of the moving pencil.

Combined Door Bell and Mail Receiver

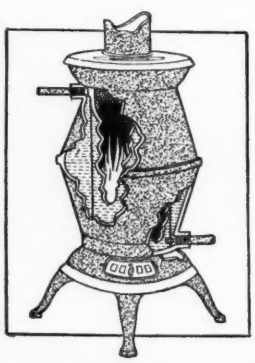


THE fulcrum which actuates the door bell is devised to act as a holder for mail. A spring in the bell holds the lengthened bar against the house at a considerable tension. The mail carrier pulls the fulcrum away from its normal position to insert the mail. This actuates the ringing mechanism of the bell.

An Aid to the Veterinary

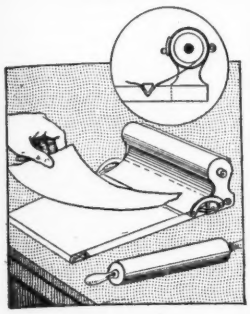
TWO pairs of pivoted jaws are equipped with teeth plates to cover the teeth of a horse. One of the jaws terminates in a set of fixed teeth, which may become engaged with a latch affixed to the other jaw. A strap holds the device in position on the head of the animal. By means of the teeth and latch, the horse's mouth may be held open during a veterinary's examination.

A Room Stove Water Heater



THE water jacket is reversible end for end, having its greatest diameter at its middle point. The walls are thickened where the cold water enters the stove, thus preventing harmful contraction or expansion of the walls.

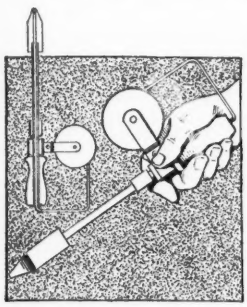
Sanitary Kneading Board



A ROLL of paper or parchment is placed at the head of this sanitary kneading board, and a sheet is drawn over the upper surface of the board when in use. When the work is done, the paper is torn off and a new sheet inserted.

This device saves the work of cleaning the board after kneading bread or cutting meat, and is thoroughly sanitary.

Self-Feeding Soldering Iron

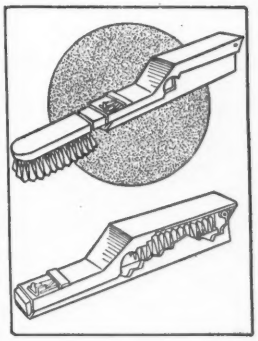


A SELF-FEEDING soldering iron is made with a tube or passage extending from the head through the shaft and handle. A reel, containing a large amount of soldering wire, is mounted above the handle, and the wire passes through the passage in the iron to the head of the tool, where it is melted by the heat and flows to the point to be soldered.

A Pad and Pencil Holder for the Telephone

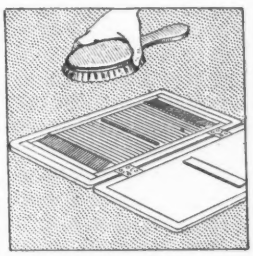
ALTHOUGH the memorandum pad is a necessity for the telephone, the ordinary pad is apt to be lost or mislaid. The accompanying illustration shows an attachment consisting of a single plate of metal curved around the telephone standard. At its upper end it is fitted with a pencil-holding clip, and its lower end is extended forward to contain a pad. The fact that the entire attachment is made in one piece makes it indestructible.

Folding Tooth Brush



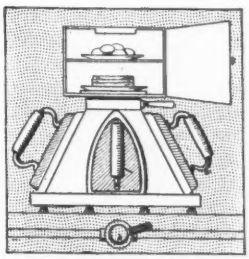
THE handle of a tooth-brush is made to form a casing which will form a cover protecting the tooth-brush when the latter is not in use. When in use the brush is held in its extended position by a spring, which is locked by a jin, and the casing forms a handle.

Apparatus For Cleaning Hair Brushes



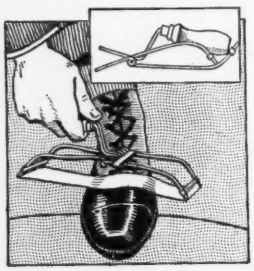
A DEVICE for cleaning hair brushes is made with a comb to remove hair and other foreign substances. A wick is kept moist by means of a moistening tray filled with a disinfecting liquid which cleanses and imparts a pleasing odor to the bristles. A tray at the bottom receives the foreign substances, which have been caught by the comb. As the brush is passed over the device, the bristles come in contact with the moistened wick. Through the friction the liquid is effectually distributed through the bristles in the form of a fine spray.

Combination Sad-Iron Heater and Cooking Utensil



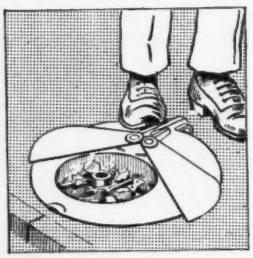
A SHEET metal body, of a pyramid form, is placed upon a metal base plate which rests over the flame. An inclined rack allows the sad-irons to be leaned against the pyramidal body of the heater. Upon the top rests a suitable oven, which may be used for cooking. Heat ascends inside the sheet iron body, thus keeping the sad-irons warm, and also heating the top and the oven.

Shoe Polishing Device



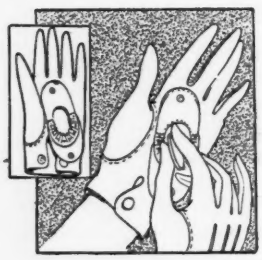
A COLLAPSIBLE shoe polishing device is made of heavy wire, hinged at several places, and held in a rigid open position for use by means of a ferrule. The polishing cloth is extended tightly across the jaws of the device, and when not needed, may be easily removed. A wooden handle is attached by means of a heavy wire.

Opening and Closing Garbage Cans with the Foot



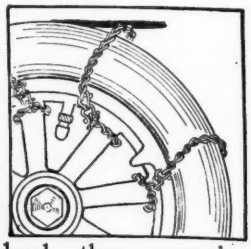
A COVER for a garbage receptacle which may be opened by a pressure from the foot, is made of a metal lid divided in the middle to form two semi-circles. The ends of these semi-circles are pivoted and terminate in metal ears. The pivot has small gears which engage to make both semi-circular covers open away from each other upon the pressure of a foot upon the ears. The covers open away from each other exposing the interior of the receptacle. When the pressure upon the metal ears is removed, a spring forces the semi-circles back into their original position, entirely covering the receptacle.

Purse In Palm of Glove



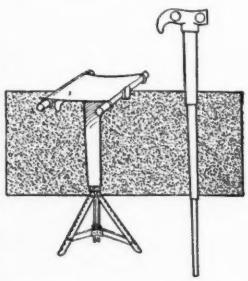
IN the palm of a glove or mitten, an elliptical coin pocket is fastened. This pocket is fitted with draw strings, so that the purse may be easily closed. In addition, a flap is sewed to the glove which closes over the entire device and is secured by a push fastener.

Anti-Skidding Chain



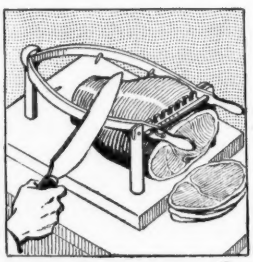
A CHAIN which may be used on any size wheel is made in short lengths, so that it may be placed in position by first passing it about one of the spokes of the wheel, then engaging one end of the chain through a link on the opposite end. This forms a loop encircling the spoke. The chain may then be passed around and around the rim and tire, and fastened with a catch to the loop.

Walking Stick Becomes a Seat



THE stick is composed of several parts and may be readily taken to pieces. At the lower end is a tripod which forms the legs for the seat. Hidden in the stick is the canvas seat, which may be stretched over the head of the cane by means of a removable sleeve designed to be threaded into the handle to form the support for the seat when the affair is set up.

Meat-Holder Which Makes Slicing Easy



UPON a marble or metal base are pivoted two jaws set with clamps for gripping a piece of meat or fowl while it is being cut or carved. If it is desired to turn over the meat, the clamps are quickly loosed and by means of handles affixed to the jaws, the operation is completed without touching the meat with the hands. A strap holds the jaws firmly in a closed, or partially closed, position.

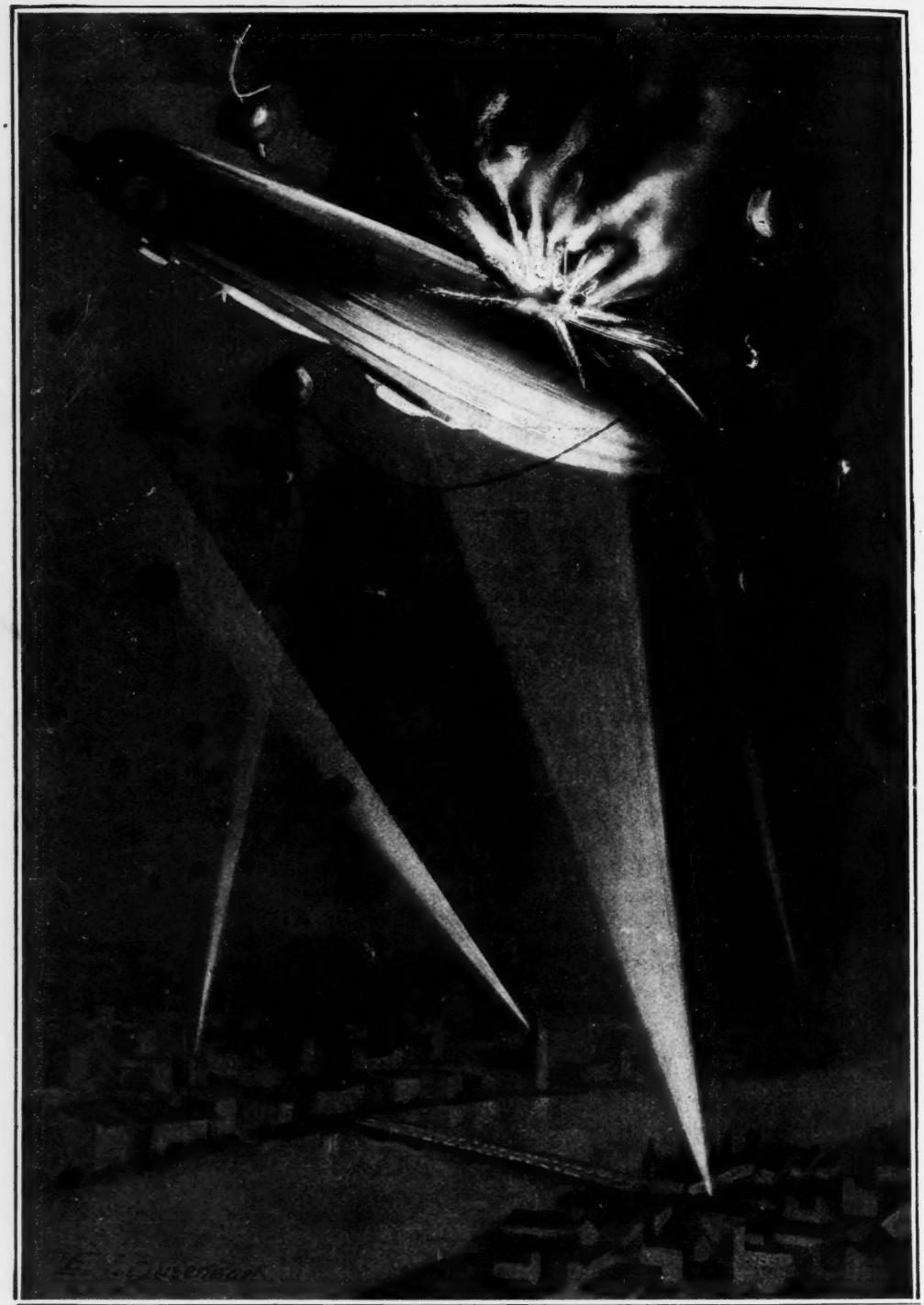
Features of the March Popular Science Monthly

Above the plank floor which now constitutes Broadway, in front of the Metropolitan Opera House, are silks and jewels and glittering lights; below it in half darkness a squad of laborers in khaki overalls, stained with sweated mud, are risking their lives to build another subway.

In the March number the unseen underground activities of New York are revealed in an absorbing article and in a dozen or more interesting pictures—done in the POPULAR SCIENCE MONTHLY *way—to show exactly how sewer pipes are being rearranged, how rock is being blasted, how a tunnel is being sunk beneath the Harlem River.*

Why did England declare cotton contraband of war? You will find out if you will read in the March number an article which traces cotton from the time that it is in the boll on some southern plantation, to the time when it is placed in the breech of a 42-centimeter gun in the form of smokeless powder of terrific energy.

Of course there are other articles equally worth reading. But how can we enumerate three hundred subjects in two hundred words?



Can This Be Done?

Joseph A. Steinmetz of Philadelphia would mine the air above London against Zeppelins as the Dardanelles are mined against battleships. He would send aloft captive hydrogen balloons carrying explosives, grappling-hooks and torches. It would be hard for the balloons to maintain their level. The wind would toss them about. What is more, a Zeppelin's machine gun could pick them off and drop them into London itself with dreadful results